October 22, 2015

RESIDENTIAL PARKING STUDY: SUMMARY OF CHANGES SINCE JULY 2015

July 2015 - Status / Strategy	Issue / Concern / Feedback	Responsiveness	Feedback on October draft	Next Steps
Draft Plan released	Full document is too long for most people to follow	• Executive summary was added • Recommendations (Chapter 5) were renumbered to be in the order of implementation	Plan is too focused on big changes Basic administrative and management strategies should be the focus Plan's Goal = quality of life in neighborhoods; Strategies = impacting quality of life	• Feedback / direction from Council and Commission • 3 options: 1) end this study and leave the program as-is, 2) have leadership confirm appropriateness of study and continue with process, 3) remove controversial pieces and finalize the Plan

Chapin + Nicole brought to meeting

General Parking Management Strategies: 1. Install parking meters / paystations 2. Establish parking time limits in mixed use areas or along arterials 3. Striping parking stalls / areas	Support for striping parking stalls to prevent blocking driveways Unclear that these can be used in lieu of OR in addition to residential parking permits Meters or pay stations shouldn't be used in some neighborhoods	• Reframed this section to more clearly describe the applicability of these strategies in relation to permit restrictions (i.e. all strategies create a toolbox of options and flexibility to manage parking) • Restructured to describe strategic vs. tactical implementation	Meters or pay stations shouldn't be used in some neighborhoods	• Clarify language re: process and neighborhoods under consideration for meters and/or paystations • Update introductory language to clarify "generate funds for neighborhood improvements" (neighborhood improvement programs were removed from this section)
Lawn Parking Bans: Strengthened recommendations: increase fine from $75 to $125 and revoke permits for the household if more than 3 violations / year	Recommendations are not strong enough, look for guidance from other communities	• Researched other communities, could not identify other strategies	Recommendations still not strong enough	

Zoning and Parking: Recommendations for parking in-lieu fees, zoning districts, and lower parking minimums	Not applicable to residential parking as a strategy This change could worsen parking pressures in neighborhoods	• Removed recommendation to adjust zoning districts and minimum parking requirements. • Moved general topic into introduction and discussion sections.		• Allow a separate process to analyze zoning recommendations
Strategy 1: Encourage and Improve Sustainable Transportation Modes **Strategy 2:** Encourage Satellite Parking on Campus and Incentivize Parking in Remote Lots	No specificity and not enough emphasis on the importance of these strategies. Existing plans are not referenced. The City needs to require more of the Institutions. The Institutions' parking plans need to be connected to this Plan. Cost of installing and maintaining parking spaces is not reflected in the report. Satellite parking should be an option for everyone, not just students	• Added relevant plans and more specific recommendations. • Acknowledged that parking may be less appropriate than sustainable transportation facilities on major corridors. • Added Joint Institutions Parking Management Plan • Added implementation steps.	Still need stronger language and more specific requirements for UVM (i.e. more than "encourage".	• Change "encourage" to "require" (as was suggested for October draft but was erroneously excluded from the final document)

Strategy 8: Charge for residential parking permits	Mixed feedback on permit fees Concern that paying for guest passes will make it more difficult to have guests Concern that any fees will be unattainable for low income families Police Department: administration of 2 year permit would be challenging to enforce City staff: purchasing vouchers to void fines is not equitable	• Discussed waiving fees for low-income residents: BPD shouldn't have to review personal income, fee considered relatable to cost of owning and maintain a vehicle • Removed 2-year permit • Removed option to purchase additional vouchers to void fines	Should state that practice of calling BPD during house parties will continue	

Strategy 9: Establish maximum number of transferable parking passes per dwelling unit **Strategy 10:** Restructure visitor passes	How will transferable permits be controlled and not shared with non-residents? Four permits per dwelling will increase parking	• Revised to have 2 fixed and 2 transferable permits (rather than 4 transferable) • Restate more sophisticated security features to diminish chance of reproduction of transferable permits • Added language to prohibit the resale of permits and the loss of all permit privileges if caught • Researched percentage of permits per dwelling above/below 4. Confirmed that there should be fewer permits issued.	Four permits per dwelling will increase parking	• Emphasize data on number of properties with >4 permits currently to illustrate the anticipated decrease in total permits (i.e. 14% of dwelling units with residential permits in 2013 had > 4 permits)

Strategy 11: Establish fixed expiration/renewal dates, pro-rated by academic calendar	Police Department: administration of all permits at one time of year would be very difficult	• Removed this strategy		
Strategy 12: Allow approved landlords to administer permits to tenants	Tenants / residents will be more invested in resolving parking issues than absentee landlords	• Removed this strategy		
Strategy 13: Establish residential parking areas rather than streets	Street-specific permits allow neighbors to know who is parked on the street; makes moving cars in emergencies more manageable How to prevent over-development that relies on parking availability in the wider area? Areas will make it easier for homes with too many cars but more difficult for residents who need to park near their homes Corner lots with driveways and primary doors on side street will be ineligible for a permit	• Revised corner lot recommendation to allow proof of frontage • Revised recommendation: no changes to the existing program at this time	Corner lots should not be able to choose Areas still make it easier for homes with too many cars but more difficult for residents who need to park near their homes	• Add to Implementation section to clearly describe neighborhood-inclusive process

Strategy 14: Pilot commuter parking program	Requiring commuter permits for newly permitted areas but not existing seems unfair Priority should be keeping neighborhoods livable, selling permits in tough financial times isn't worth it Commuters who park in neighborhoods do so because they can't afford a permit and still won't be able to afford a permit Pilot program duration is unclear	• Noted that commuter permits should not be issued in areas where Institutions are creating the demand for commuter permits. • Clarified duration of pilot program.	Priority should be keeping neighborhoods livable, allowing commuters doesn't fit	• Solicit additional community feedback and direction from Council and Commission • Enhance Implementation language to emphasize schedule of 3-year pilot: 1 year for DPW to prepare, 2 years of neighborhood pilot upon initiation of new residential permit restriction

Petition Process Strategy 1, 2, 3: Demonstrated Community Support Demonstrated Parking Demand To Remove or Reallocate Residential Parking	Low income households will struggle to meet the public process requirements to request residential parking restrictions but they may be the most impacted by parking spillover	• Revisited option to have residents or property owner sign initial petition. Kept property owner as initial signee, understanding that residents can participate in discussion after initial petition • Strategies that specifically reduce impacts on lower income residents were not found in the best practices review	Process to remove or reallocate permit restrictions doesn't allow City to initiate changes, but changes may be needed to implement other transportation improvements	• Add language about other processes that may impact current parking restrictions
Strategy 3: Establish residential parking permit hours based on parking demand, by hours or days of the week				
Strategy 4: Clear signage				

Strategy 5: Online or mailed residential parking resources				
Strategy 6: More information on a user-friendly website and printed materials				
Strategy 7: Coordinated Virtual Parking Permits				
General Comments	Plan undermines impact of parking on quality of life	• Restructured Goals and Objectives to emphasize the importance of neighborhood livability		
	Property values are impacted by parking but this is not reflected in the report	• Revised section on property taxes and residential parking		
	Shared parking with private parking lots is included in the Downtown conversation but not this Plan			• Add to Tactical Parking Strategies (as was suggested for October draft but was erroneously excluded from the final document)

	Case study on Ithaca is 90% incorrect	• Contacted Ithaca again. Confirmed accuracy and updated report for clarity.		
	Conflict of interest with UVM representative also on Public Works Commission	• City Attorney confirmed there is no conflict of interest		
	License Plate Reader (LPR) technology pays for itself and is very effective	• Still recommended as a long-term strategy	This technology raises privacy concerns	
	This process has not really allowed residents or the Advisory Committee to feel heard	• Updated Draft plan based on comments. Provided summary of changes.	Residents and the Advisory Committee do not feel heard	• Updated Summary of Changes since October 20 to be comprehensive • See Row 1

Residential Parking Plan

General and Permit Program Strategies and Implementation Schedule – Oct. 2015

		Description	Responsible City Department/Agency	
			Lead	Supporting Department/Agency
General Parking Management Approaches	Strategic Approaches	Encourage and Improve Sustainable Transportation Modes	DPW	CEDO, Planning, CATMA, CCTA, CCRPC, CarShareVT, Institutions
		Encourage Satellite Parking and Incentivize Parking in Remote Lots	DPW	CEDO, Planning, CATMA, Institutions, CCTA
		Improve Signage and Wayfinding	DPW	
	Tactical Approaches	Install Parking Meters/Paystations	DPW	Burlington Police Department
		Implement Parking Time Limits in Non-RPP Areas	DPW	
		Stripe Parking Stalls	DPW	Burlington Police Department
		Improve Lawn Parking Ban Enforcement	BPD	DPW, Code Enforcement
Short-Term Residential Permit Program Strategies				
0-1 year	1	Provide Online Residential Permit Resources: Downloadable Application and Renewal Documents	BPD	DPW
	2	Establish Commuter Parking Permit Program (3-Year Pilot Program)	DPW	Burlington Police Department
	3	Establish Residential Parking Permit Periods Based on Supply and Demand	DPW	Burlington Police Department
	4	Evaluate Residential Parking Areas Rather Than Streets	DPW	Burlington Police Department
	5	Streamline the Process for Petitioning for Resident-Only Parking	DPW	Burlington Police Department
	6	Establish Process for Removing or Reallocating Residential Parking	DPW	Burlington Police Department
Mid-Term Residential Permit Program Strategies				
1-3 years	1 (mid-term)	Provide Online Residential Permit Resources: Comprehensive Program Information	DPW	Burlington Police Department
	7	Revise Program to Incorporate Fee Structure and to Allocate a Maximum of 4 Permits per Dwelling Unit	BPD	DPW, Planning
	8	Establish Construction and In-Home Care Permits	BPD	DPW, Planning
Long-Term Residential Permit Program Strategies				
>3 years	1 (long-term)	Provide Online Residential Permit Resources: Online Payment of Permits and Fines	DPW	Burlington Police Department
	9	Improve Enforcement Technology	BPD	DPW

BURLINGTON

Parking & Transportation Plans

DESMAN ASSOCIATES RSG

Presentation to Public Works Commission

October 28, 2015

Chapin had me print off prior to meeting for Commissioners.

Three Parking & Transportation Plans

1. **Downtown Parking & Transportation Plan** (Desman Associates)
2. **Residential Parking Management Plan** (RSG)
3. **Transportation Demand Management Action Plan** (RSG)

All plans online at
www.ParkBurlington.com

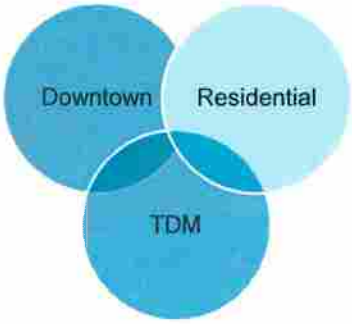
The Three Plans Work Together - Downtown

- Expands parking availability downtown by opening up private spaces to public use and better utilizing public spaces
- Provides a range of parking options
- Increases convenience to encourage parking where it is intended
- Identifies potential areas for future parking expansion when needed

The Three Plans Work Together - TDM

- Provides a menu of incentives to help commuters and others get to work in a variety of ways
- Provides employers with a coordinated program of mobility options for their employees
- Reduces commuter parking demand so that visitors, shoppers and others can more easily find spaces

The Three Plans Work Together - Residential



- Preserves and updates the Residential Permit Program (RPP) so that parking demand continues to be managed in high-demand areas
- Expands the toolbox of management approaches to give residents and the City more options to flexibly address parking demand
- Addresses multiple competing demands on public ROW by calling for shared, multi-modal solutions

BURLINGTON

Downtown Parking & Transportation Plan

Presentation to Public Works Commission
October 28, 2015

Downtown Parking & Transportation

State of system when Downtown Parking Initiative launched (2013)

- **Deteriorated garages and equipment** due to inadequate funding for PM and capital reinvestment
- **The Traffic Fund had virtually no fund balance** – and was only staying solvent by deferring necessary reinvestment
- **Customers complained about having only one way to pay**, garage cleanliness and safety, inability to find parking in the absence of clear wayfinding or parking information
- **No public/private entity to guide transportation / parking policy** or promote transportation options downtown – unlike our peer cities of Ann Arbor and Boulder

Desman's Major Recommendations

- **Offer a range of parking options** and price points that reflect demand
- **Establish a public/private policy body** to coordinate parking and transportation policy and services downtown
- **Deliver downtown-wide menu of transportation options** to all downtown employers and employees
- **Complete $9M garage capital repairs** by 2018
- **Expand payment options** including pay-by-cell
- **Retool 2-hour free parking** and launch merchant validation program
- Don't enforce Sunday mornings, but **enforce Sundays after noon** in the downtown core
- **Add secure bicycle parking** as part of downtown parking strategy
- **Improve education and marketing** through improved wayfinding, apps, online resources

Progress Well Underway

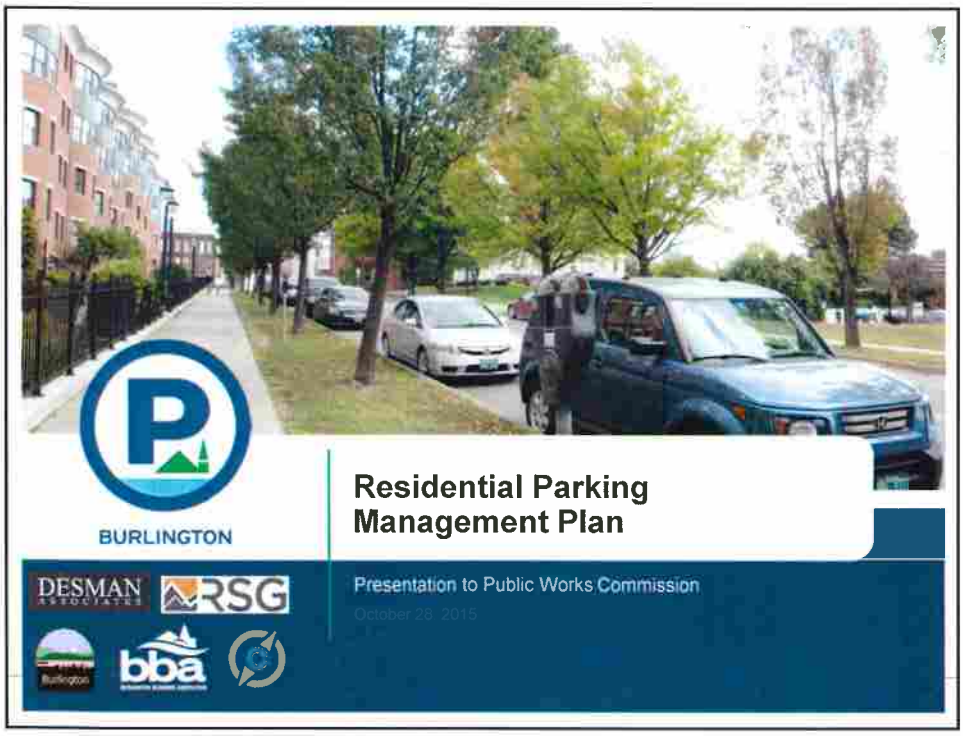
- Installed 280 **smart meters**
- Traffic Fund **outperformed its budget** in FY'15
- Completed **structural assessment** and capital needs for garages
- Initiated first phase ($800K) of **garage capital repairs**
- Installing **wayfinding**, including dynamic garage signs, being installed
- Launching **pay by cell** in 2015
- Conducting regular **data collection**

Downtown Parking & Transportation

The Traffic Fund has the potential to be a transformative tool for the future mobility needs of downtown

- **Provide commute incentives** like discounted bus passes to downtown employees
- **Improve pedestrian links to parking** and improve bike parking
- **Launch or expand mobility innovations** in our system (pay-by-cell, adaptive signal control, carsharing, dynamic signage, online ticket payments, etc)

Ann Arbor's Downtown Parking & Transportation Resource



Residential Parking Management Plan

Purpose of plan is to comprehensively review and modernize the current Residential Permit Program (~25 years old) and propose additional management tools.

- Re-evaluation of RPP called for in 2014 Municipal Dev. Plan
- Concerns with existing RPP included unclear/unfair process, challenge with voiding tickets, treatment of corner lots
- City's responsibility manage competing demands on public ROW, the right balance is often location specific
- Based on public input, a number of recommendations were removed or revised in current draft (see handout for detail)
- Advisory Cmte members continue to have concerns with plan
- Staff responding by ending consultant contract and staff will work directly with Advisory Cmte to make additional revisions

General Parking Management Approaches

"The City should continue to pursue several parking management strategies outside of the formal RPP to create convenient visitor parking, encourage turnover, and generate funds for neighborhood/transportation improvements."

Strategic Approaches:

- Encourage and Improve Sustainable Transportation Modes
- Encourage Satellite Parking and Incentivize Parking in Remote Lots
- Improve Signage and Wayfinding

General Parking Management Approaches

Tactical Approaches:

Providing a menu of options for managing public parking in areas of high parking demand:

- **Establish parking time limits** – such as Olympia, WA (see picture)
- **Install meters or pay stations** -- in mixed-use areas or in areas adjacent to recreational, commercial or downtown zones
- **Stripe parking spaces and stalls** to prevent blocked driveways, etc.
- **Strengthen enforcement of lawn parking** -- increase the fine by 66% and revoke RPP permits for repeat offenders
- All can be used in RPP or non-RPP areas

Residential Parking Management Plan

9 Residential Permit Program strategies preserve and update the program. Components include:

- **Maintaining street-level RPP areas** at this time – recommendation revised based on public input
- **Implementing anti-counterfeiting measures** -- proposes penalties including potential revocation of RPP permits for anyone found to have sold or forged permits
- **Proposing one "Oops" voucher** for each permit per year to void an inadvertent ticket
- **Capping, for the first time, the number of permits** to 4 per unit. In 2013, 14% of units had more than 4 permits – should reduce total permits

Permit limits per unit – now and proposed

Current System:

- Guest Permit
- Guest Permit
- Resident Permit
- Resident Permit
- Resident Permit
- Resident Permit

As many permits as there are vehicles at a particular address

In 2013, 14% of units had more than four permits.

Proposed System:

- Transferable Permit
- Transferable Permit
- Resident Permit
- Resident Permit

Residential Parking Management Plan

9 Residential Permit Program strategies preserve and update the program. Components include: (cont.)

- **Proposes new online resources** -- forms, renewals, tickets payment.
- **Streamlines the petition process** – providing a clearer path for RPP designation, modification or removal
- **Preserves the flexibility** to call parking enforcement when hosting a large party to accommodate visitors.
- **Paying for permits** – Staff reviewed four comparable small cities and they all fund the operation and improvement of the program in part through permit fees. We are proposing to do the same.

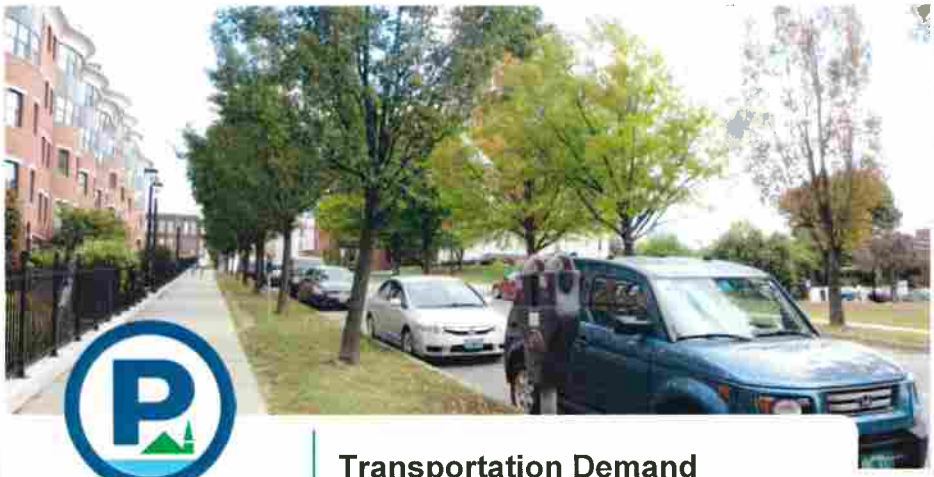
	Annual Resident Permit Cost	Cost of Additional Permit
1 Permit	$10	
2 Permits	$40	$30
3 Permits	$80	$40
4 Permits	$130	$50

Residential Parking Management Plan

9 Residential Permit Program strategies preserve and update the program. Components include: (cont.)

- **Commuter Permit Pilot** – seeks to balance parking needs while generating funds for neighborhood/transportation improvements.
  - Proposed 3 year trial
  - Offer a limited number of commuter permits on specific permit-restricted blocks that have demonstrated surplus parking during working hours.
  - Opt-in only for existing RPP streets, could be required for future RPP streets
  - Not recommended for streets where demand is projected to come primarily from one of the institutions
  - Provides residents discounted RPP permits in return

☆ lot of concern - want to hear on this one



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Transportation Demand Management Action Plan

DESMAN ASSOCIATES RSG

Presentation to Public Works Commission

October 28, 2015

Burlington bba

Transportation Demand Mgmt. Action Plan

The plan's goal is to create a set of short and long-term TDM recommendations that will:

- Offer City employees a more coordinated suite of transportation services
- Serve as a model for other downtown employers

Short term City strategies include:

- Developing a flex time policy
- Having a TDM Coordinator in Human Resources department
- Implementing Universal Transit Pass and Parking Cash-out options for City employees
- Providing enhanced commuter resources through City's membership with Chittenden Area Transportation Management Association (CATMA)

BURLINGTON

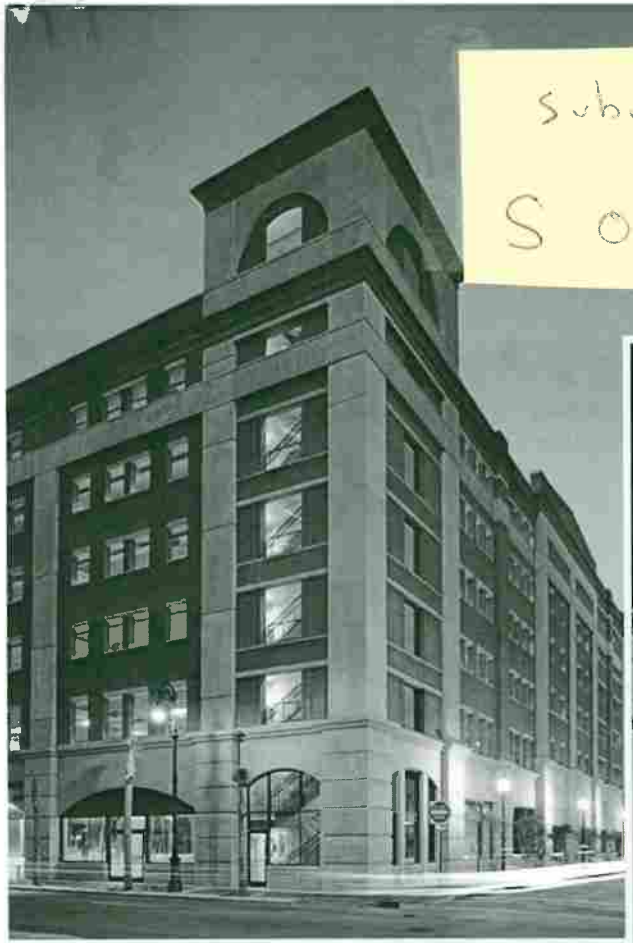
TIMELINE

- Oct 16: Plans posted on www.ParkBurlington.com
- Oct 20: Residential Plan Advisory Committee
- Oct 20: Police Commission
- Oct 26: City Council
- Oct 27: Planning Commission
- Oct 28: DPW Commission
- Nov 5: Parks Commission
- Nov 5: Ward 6 NPA
- Nov 11: Ward 1 NPA
- Nov 15: Public comment period concludes
- Nov 18: Church St Marketplace Commission
- Late November: Final draft plans released
- Nov 30: Downtown Advisory Committee (email approval)
- Dec 7 or 21: Council votes on downtown plan
- Dec 16: DPW Commission votes on residential plan

NOTE: Plans only recommend changes. All major changes will require additional public process.

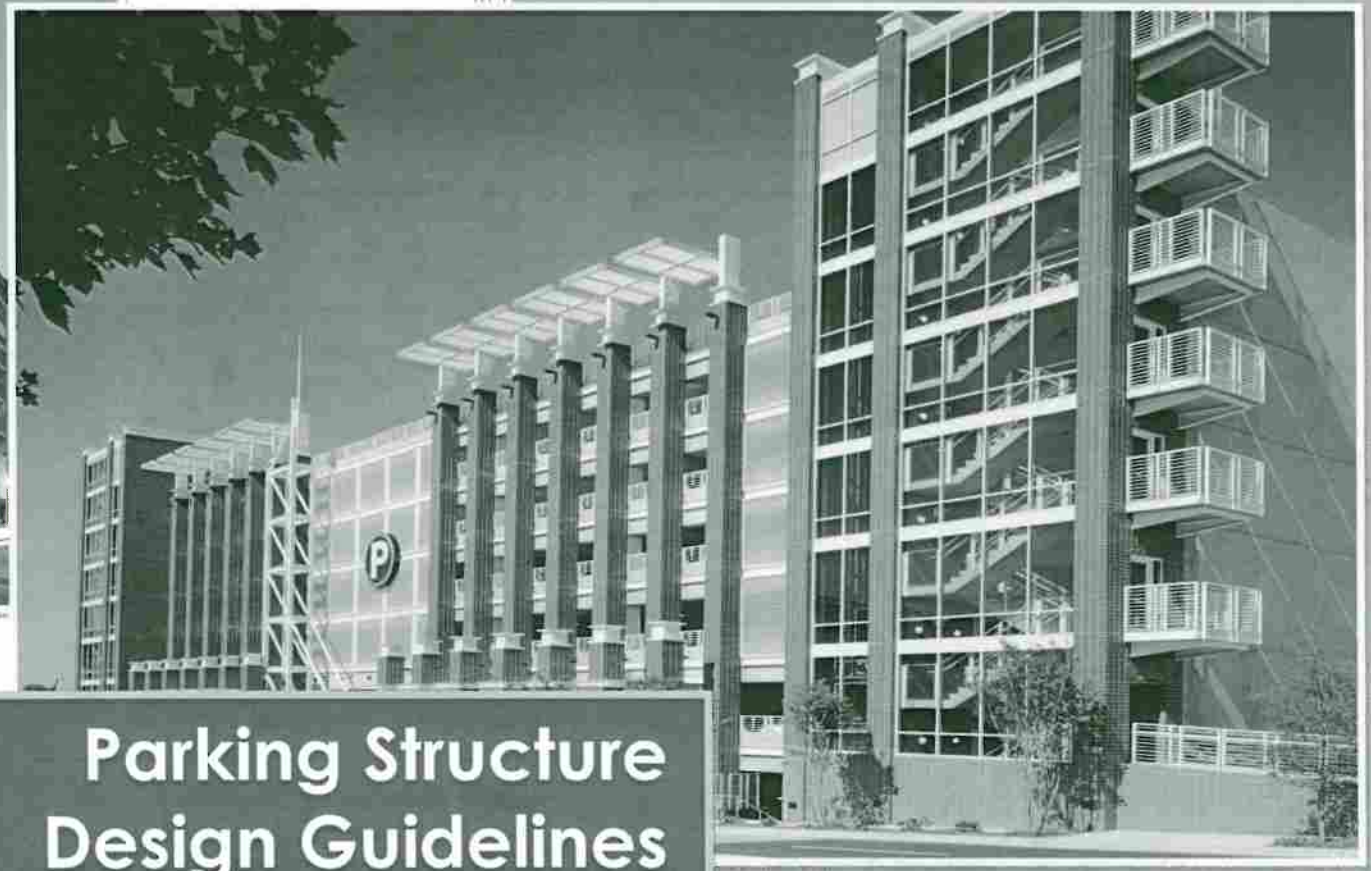
Submitted by

S Overby



Prepared for:

City of Lincoln
Lincoln, Nebraska



CITY OF LINCOLN
NEBRASKA
MAYOR CHRIS BEUTLER

Parking Structure Design Guidelines

Carl Walker Parking
Planning Engineering Restoration

Ideas for parking. SOLUTIONS FOR PEOPLE.

Prepared by:

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950 West Elliott Rd., Suite 107
Tempe, AZ 85284

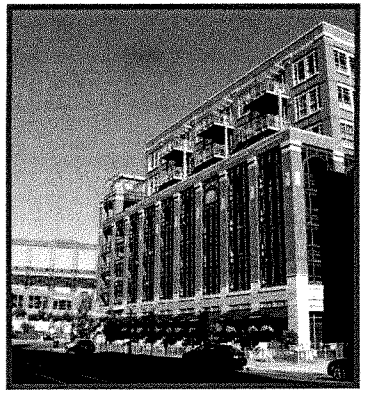
PARKING STRUCTURE DESIGN GUIDELINES

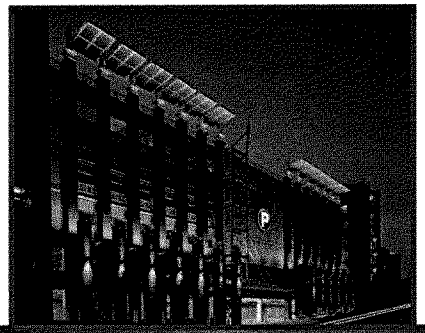
Introduction

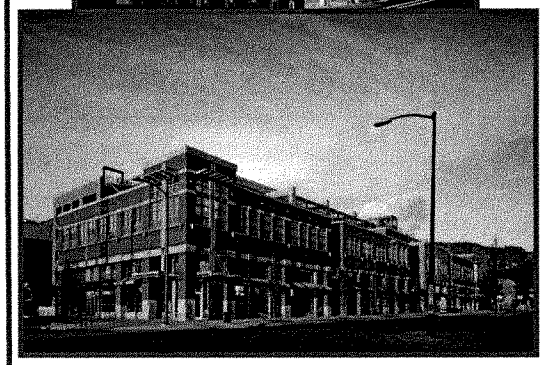
This document was developed for the City of Lincoln as a guide for future parking structure design in Downtown Lincoln. It contains information to help developers and designers incorporate parking structure components into proposed projects. The concepts presented will help produce functional, well-designed and patron friendly parking structures that will become valued infrastructure elements for the Downtown. The concepts are presented so that common design mistakes can be avoided by being addressed early in the design process. The document is based on ***Carl Walker's*** internal *Guidelines for Functional Parking Design* and should be periodically updated to reflect state-of-the-art parking design practices and principles. It includes the following categories:

- Project Delivery
- Sustainable Design - LEED
- Site Requirements
- Site Constraints
- Concept Design
- Circulation and Ramping
- Access Design
- Parking Geometrics
- Parking Layout Efficiency
- Vehicular Entry / Exit Lanes
- Pedestrian Requirements
- Accessible Parking Requirements
- Safety and Security
- Lighting
- Signage and Wayfinding
- Drainage
- Open or Enclosed Parking Structures
- Structural Systems
- Durability Design
- Other Considerations

In any future parking development project it is highly recommended that qualified parking structure design specialty firm be engaged to lead the project due to the unique characteristics and design expertise required to develop a successful project.







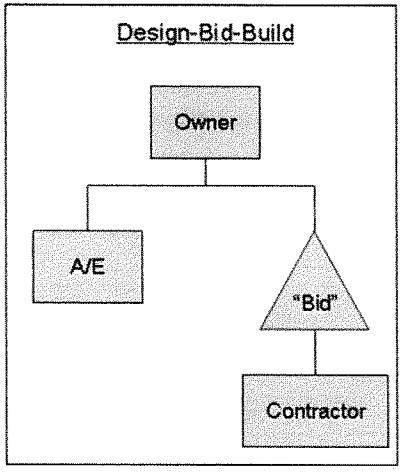
Project Delivery

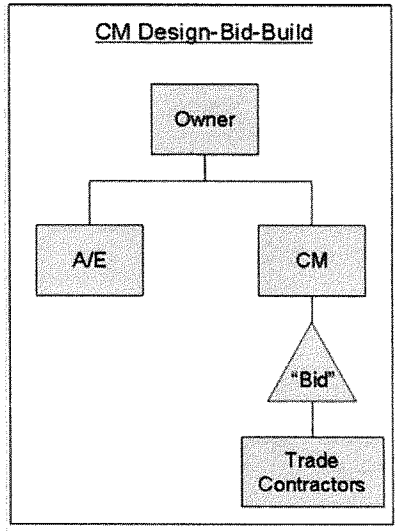
There are four primary project delivery methods commonly used to design and construct parking structures. Two Design Professional's Handbooks titled the *Design-Build Project Delivery* and the *Design/Contract-Build Project Delivery,* published by the American Council of Engineering Companies (ACEC), are helpful references.

Each method is described on the following pages, along with a graphical depiction of the contractual relationships for each:

1. Design-Bid-Build (D-B-B) projects are those where the owner selects and contracts with the lead designer (Parking Consultant or Architect/Engineer). They in turn represent the owner in defining the project and preparing drawings and specifications to meet the owner's needs for competitive bidding to contractors. Often on public projects the owner is required to select the lowest "responsive and responsible" bid, with the contractors' qualifications often not given consideration. The D-B-B method is sometimes referred to as the "traditional" process and is still the most common method.

2. Design-Bid-Build with a Construction Manager (CM) is where the owner selects and contracts with the A/E who represents the owner in defining the project and preparing drawings and specifications to meet the owner's needs for bidding. However, the owner also retains a construction manager (CM) who works with the A/E during the design phases, sets the project schedule, and performs construction cost estimates. The CM bids the work to subcontractors for the various trades. This is a better method than D-B-B for projects where the owner wants fast track or phased construction.

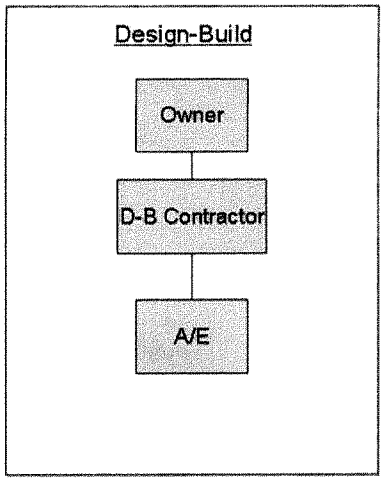


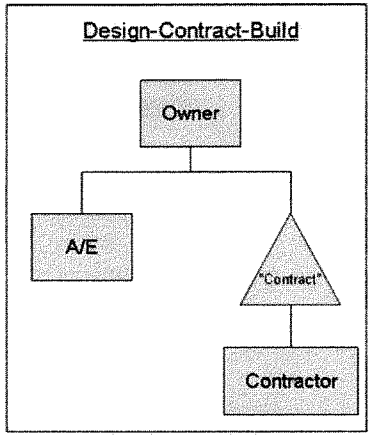


PARKING STRUCTURE DESIGN GUIDELINES

3. *Design-Build (D-B).* In this case, the owner retains a D-B contractor who in turn retains the A/E so there is a single entity responsible for both design and construction. Often the owner prepares or retains another A/E to prepare design build criteria documents as described below. Often, the owner can select the D-B team based on qualifications and cost, consistent with the bidding documents. There has been more interest in D-B type projects recently because of owners who perceive benefits regarding cost, schedule, and risk management.

4. *Design-Contract-Build (D-C-B)* are projects where the owner selects and contracts with the A/E. The A/E prepares preliminary documents that are the basis for the owner contracting with the contractor early in the design process, rather than waiting for final design documents to be prepared as for D-B-B. This method combines the advantages of the D-B-B and D-B methods while reducing many disadvantages to allow the owner to have the most qualified A/E and contractor involved in their project from the design phase through the completion of construction.





PARKING STRUCTURE DESIGN GUIDELINES

In recent years there has been an increasing interest and use of Design-Build in the construction of parking structures. Legislation has been enacted in many states to allow D-B to be used by public entities because prior laws required publicly funded construction contracts to be awarded based upon completed design documents.

Advantages of Design Build:

- Owner has a single point of responsibility for design and construction.
- Potential for better design and construction coordination because the A/E is working for the contractor.
- Owner does not have to arbitrate disputes between the A/E and contractor.
- Owner reduces their risk because the D/B contractor is responsible for errors or omissions in the design documents.
- Could be less administrative burden on the owner.
- Potential for accelerated schedule because the contractor is onboard at the beginning and because of the overlapping of design and construction work.
- Potential for lower costs due to the contractor being in greater control of the project and due to the accelerated schedule.
- Costs are well defined earlier in the process

Disadvantages of Design Build:

- The D-B contractor has the incentive to complete projects faster and less expensively which can mean reduced quality of materials and workmanship.
- The owner has less involvement and control of the design because the A/E represents the D-B contractor's best interests, not the owner's. Not only is this a disadvantage for the owner, but it creates a difficult conflict of interest for the A/E.
- The owner does not benefit from independent advice and input from the A/E and contractor.
- Greater definition of the project is required up front to define goals, objectives, and minimum requirements for project function, appearance, quality, materials, operation, etc. prior to bidding to D-B teams.
- More risk for D-B teams, which can negate the potential cost saving opportunities.

PARKING STRUCTURE DESIGN GUIDELINES

When owners decide that D-B is right for their project, they can have a better chance of achieving a successful project utilizing the following procedures.

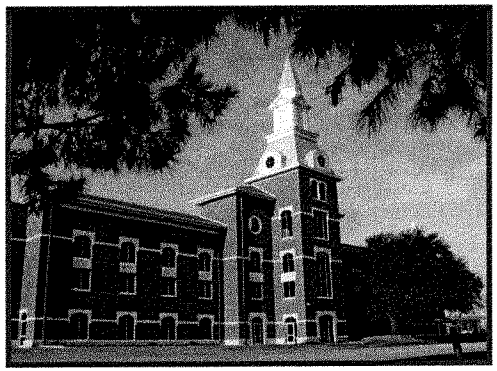
Recommendations Regarding the Design-Build Delivery Method:

1. The owner should retain an A/E at project initiation to prepare the D-B criteria documents. This allows the owner to have more input into the concept design and set standards and criteria for the project. Also, due to the uniqueness of parking structures, it is important to have the A/E led by a parking consultant or for a parking consultant to have a significant role on the design team.

2. D-B criteria documents should clearly define the project scope, function, appearance, quality, materials, and operations. The level of completeness of these documents varies, but generally they are in the 10 to 30 percent range (between Schematic Design and Design Development level of completeness).

3. The owner should use a very transparent selection process to hire the D-B contractor, using the D-B criteria documents as the basis of the Request for Qualifications/Proposals (RFQ/RFP).

4. The selection process should consider the D-B teams' technical qualifications and experience in addition to cost. Typically there is a weighting of selection criteria such as the experience and expertise of the firms and key personnel making up the team, experience of the team working together, technical merits of design, project appearance, quality and safety programs of the contractor, references, schedule, and cost. The selection criteria and weighting should be defined in the RFQ/RFP.



Parking structure built using the Design-Build delivery method for Baylor University.

5. The owner's A/E who prepared the D-B criteria documents should continue on during the final design and construction to represent the owner's interest and help assure that the design and construction are completed in conformance with the D-B criteria documents.

As an alternative to using the D-B method, the D-C-B or CM methods can often result in a project that meets the owner's best interests because:

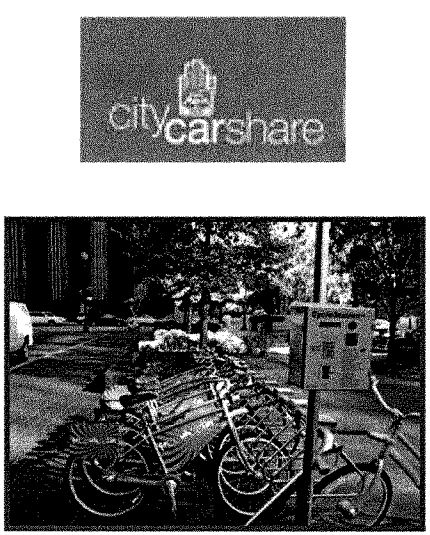
- The A/E contracts to the owner, thus representing their interests, not the contractors, which should enhance quality
- Design decisions can more easily be made that are in the best long-term interest of the owner, considering factors that will provide the lowest life cycle maintenance or operational cost, rather than emphasizing those that just provide the lowest first cost or schedule advantage
- The CM or contractor is onboard early in the design process so the A/E and contractor collaborate during design, enhancing innovation and opportunities to consider the contractor's cost saving ideas
- Similar schedule and cost advantages compared to D-B.
- Less risk for all parties as responsibilities can be allocated where they most belong

Successful parking structure projects have been completed using all four of the construction methods discussed above. Understanding the advantages and disadvantages of each and following a process to address them will help assure that the completed project is a success for the user, owner, community, designer and builder.

Sustainable Design – LEED Accreditation

While it is possible for parking structures to achieve certification, typically only occupied buildings receive certification for their sustainable design through the U.S. Green Building Councils (USGBC) Leadership in Energy and Environmental Design (LEED) accreditation program. However, parking structures that are part of a mixed use project can help attain LEED points for the entire building project. The fact that stand-alone parking structures are generally not LEED certified should not discourage including sustainable design elements in parking structures. Examples of sustainable design features for parking structures include:

- Solar panel sunshades on the top levels that generate electricity.
- Energy efficient light sources such as fluorescent, induction, and light emitting diodes (LED).
- VOC – compliant waterproofing materials.
- Bicycle storage lockers.
- Recycled materials such as silica fume, fly ash, and steel.
- Green-roof waterproofing systems and vegetation materials.
- Interior light wells to lighting and ventilation energy consumption.

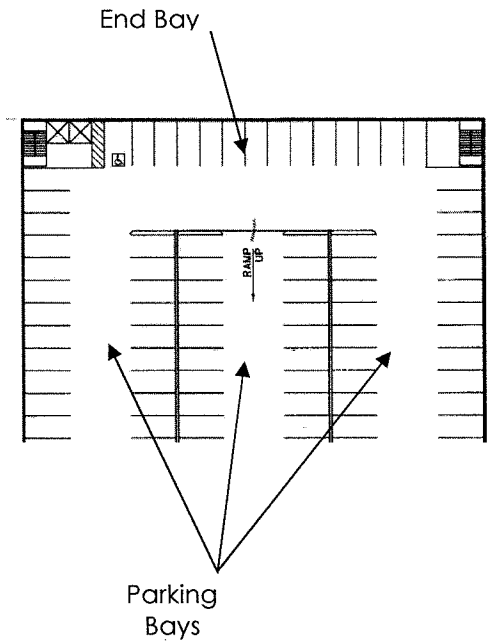


PARKING STRUCTURE DESIGN GUIDELINES

Site Requirements

Large and rectangular shaped sites are ideal for parking structures. Although flat sites are generally more economical to develop, sloped sites can provide design opportunities such as access on different levels and/or no ramping between levels. For a reasonably efficient parking layout, double-loaded parking "bays" range in width from about 54 to 60 feet, depending upon the angle of parking and the width of the parking space. The overall width of the structure should be determined based upon multiples of the chosen parking bay width. An ideal length for a parking structure is at least 240 feet. Longer sites provide the opportunity to park along the end bays, which provides more parking spaces, improves efficiency, and lowers the cost per space. A longer site also allows for shallower ramps which provide improved user comfort.

Generally, parking bays should be oriented parallel to the longer dimension of the site and preferably in the predominate direction of pedestrian travel. Walking distance tolerances from parking to a primary destination are typically 200 to 300 feet for shoppers, 500 to 800 feet for downtown employees, and 1,500 to 2,000 feet for special event patrons and students.



Carl Walker Parking
Planning Engineering Restoration

Site Constraints

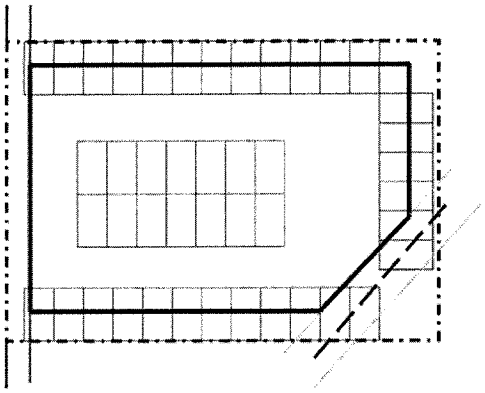
Other site issues to be considered when evaluating a potential site for a suitable parking facility include the following:

- Site Survey – a topographic survey of the site is a very important precursor to develop a conceptual plan. The site survey should delineate property lines, easements, and utility lines.

- Site Slope – The topographic information will define the slope of the site. Sometimes the slope of a site can used to reduce internal ramping in a parking structure, resulting in significantly lower costs. A parking structure that is built into a hillside can also reduce the visual mass of the facility.

- Geotechnical & Soils – Obtaining a soils report with sample borings and a geotechnical analysis early in the design process is prudent. If soils with poor bearing capacity are present on the site, the added cost for structural foundations can be significant.

- Codes and Ordinances – Municipal ordinances often specify setbacks, building height and bulk limitations, floor area ratio to site area, etc. than can significantly affect the allowable area on a site for a parking structure. The local planning organization may also impose development guidelines that must be followed.



Concept Design

Much of the remainder of these guidelines addresses issues and elements of parking structures that should be considerations during the conceptual design phase.

Parking Structures for People

An overall design principal to keep in mind is that parking structures are for people. Designing to accommodate the users of a particular structure will help produce a better parking structure.

- Different user types will have different needs
- Some user types may need to be physically separated to ensure revenue control or for security reasons.
- Different users require different pedestrian circulation systems
- Parking space widths and circulation geometry needs vary depending on the user type.
- Some vehicular circulation system are better for specific user types:
    - Residential – Regular users enter and exit two times a day.
    - Education – May have peak loads in and out.
    - Hotel – Overnight guests, maybe event parking too.
    - Office – Low turnover. Regular users enter and exit two times a day.
    - Health Care Visitors –Wayfinding very important. Need to accommodate elderly drivers and passengers.
    - Health Care Staff – Shift time overlap and loading. Security issues at particularly at night.

PARKING STRUCTURE DESIGN GUIDELINES

- Retail – High turnover. Occasional users - wayfinding to and from vehicle.
- Elderly or Families with Small Children – Wayfinding again important. May need larger spaces and more elevators.
- Events – Easy quick loading and unloading of structure. Multiple vehicular paths. Consider revenue collection method – typically flat fee on entry. Provide queuing space. Consider pedestrian flow to event - avoid crossing traffic.

Circulation and Ramping

The basic circulation element for a parking structure is the continuous ramp with parking on both sides of the drive aisle. In continuous ramp structures, some of the parking floors are sloped in order for traffic to circulate from one level to another. Only on a sloping site that permits direct access to each level from the exterior roadways are ramps unnecessary; but they still may be desirable for internal circulation.

The basic criteria for choosing a circulation system are the simplicity or complexity of the system and the architectural compatibility. Ingress and egress capacities are also a consideration in the selection of a circulation system. Some circulation systems provide the opportunity for level façades which may be desirable.

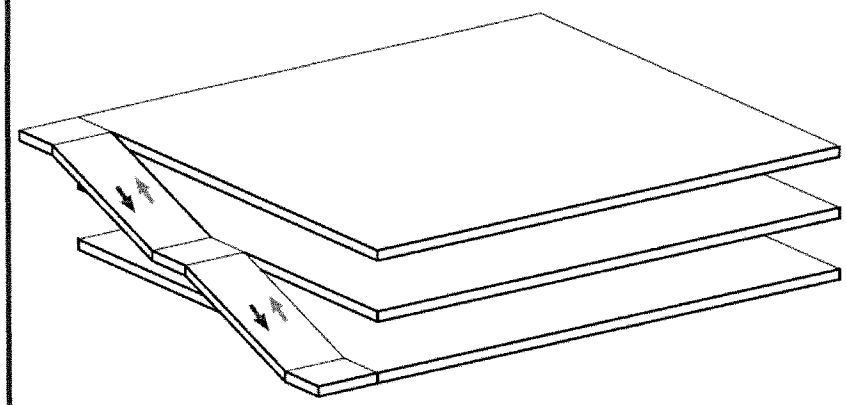
A parking ramp slope of 5% or less is preferred, although parking ramp slopes up to 7% are tolerated by the public in very dense urban areas. Parking ramp slopes should not exceed a 6.67% slope, which is the maximum parking slope permitted in the International Building Code (IBC).

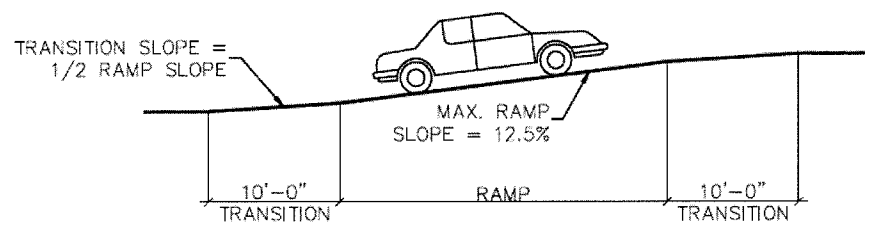
PARKING STRUCTURE DESIGN GUIDELINES

Non-parking ramps are often employed at airports, casinos, large retail structures, for special event structures, and on small and irregularly shaped sites. Non-parking ramps consist of circular helixes (most common), express ramps (external), and speed ramps (internal). Non-parking ramp slopes should have a maximum slope in the 12% to 14% range. Non-parking ramp slopes up to 20% are sometimes considered if covered or equipped with snow melt systems.

Parking structures with non-parking ramps tend to be less efficient in terms of square feet of structure per sparking space which directly increases the construction cost per parking space.

A grade difference of 8% or more requires transition slopes so vehicles do not bottom out. Recommended are minimum 10'-0" transition slopes at the top and bottom of the ramp that are one-half of the differential slope. For instance, two 10'-0" transition ramps sloped at 6.25% would be required at the bottom and the top of a ramp sloped at 12.5%.





PARKING STRUCTURE DESIGN GUIDELINES

One-Way vs. Two-Way Traffic

One of the primary factors in the design of parking structure is determining the traffic flow; one-way or two-way. Typically, a parking bay for a one-way traffic flow is narrower than for a two-way flow. The available site dimensions will influence the parking bay width and thus also influence the circulation pattern. There are advantages and disadvantages to both circulation patterns. One-way traffic flow should never be combined with 90° parking. In parking facilities with one-way traffic flow, the angle of the parking stalls establishes the direction of vehicle traffic.

Advantages of One-Way Traffic Flow:

- Easier for parkers to enter/exit parking spaces.
- Vehicles are more likely to be centered in angled spaces.
- Less circulation conflict and reduced potential for accidents.
- Better visibility when backing out of a stall.
- Separation of inbound and outbound traffic and improved flow capacity of the circulation system.
- The intended traffic flow is self-enforcing.
- One-way traffic allows the angle of parking to be changed to accommodate changes in vehicle sizes.

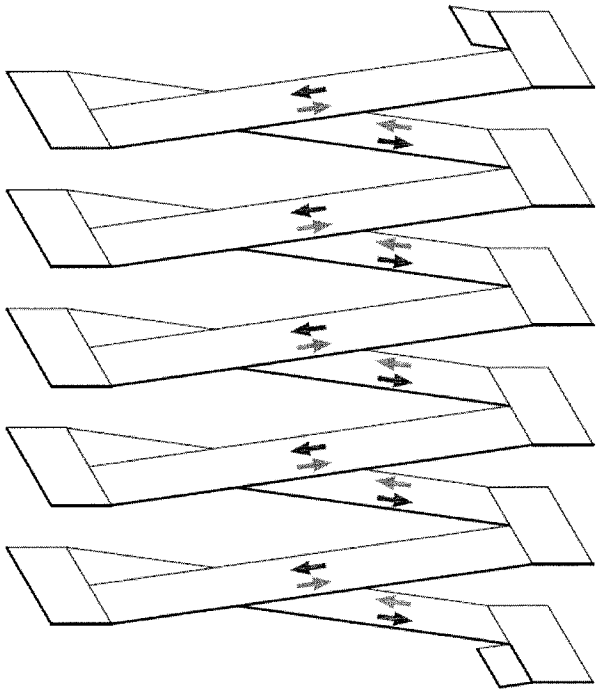
Advantages of Two-Way Traffic Flow:

- Wider drive aisles allow parkers to pass other vehicles.
- Wider drive aisles are safer for pedestrians.
- Better angle of visibility when searching for a parking space.
- Traffic flow follows its own pattern rather than one that is forced.
- Two-way traffic and 90° parking makes more efficient use of parking aisles (more spaces in a run).
- Two-way parking facilities can essentially operate as one-way facilities when there is heavy directional traffic.

Single Threaded Design

In order to develop a reasonably efficient free-standing parking structure, the **minimum** dimensions needed are about 122 feet in width by 155 feet in length. A width of 122 feet allows for a two-bay facility with two-way traffic flow and 90-degree parking. A facility with two-way traffic and a five-foot rise along each bay requires approximately 155 feet in length for a minimum floor-to-floor height of about ten feet. That is, one 360-degree turn within the facility equates to a vertical rise of ten feet. A structure in this configuration has sloping floors along both façade sides. However, sloping floors can make façade treatments challenging. On larger sites that allow a structure length of about 255 feet, one bay can be sloped rising 10 feet with opposite façade having a "level" floor.

Because of the number of 360° turns needed to ascend in a single threaded structure, the number of levels (floors) should preferably be limited to a maximum of six, otherwise the number of turns required and the number of spaces passed becomes inconvenient. A structure with a two-bay single thread design has a capacity for a maximum of approximately 750 spaces. The isometric diagram to the right represents a two-bay single-threaded helix.



Single Threaded Helix with Sloping Floors

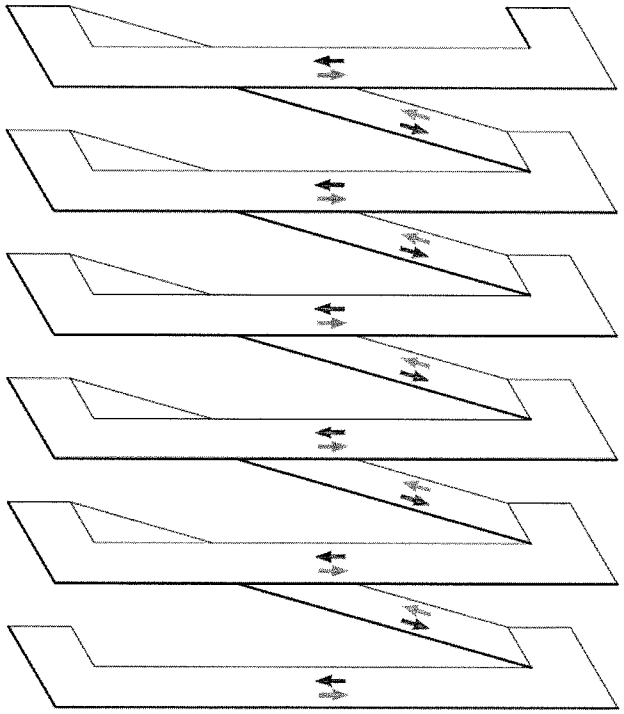
PARKING STRUCTURE DESIGN GUIDELINES

Principal Advantages of a Single-Threaded Helix:

- Repetitive and easy to understand for users.
- Potentially more flat-floor parking and level façade elements.
- Better visibility across the structure, which enhances security.

Principal Disadvantages of a Single-Threaded Helix:

- More revolutions required going from bottom to top and top to bottom.
- Two-way traffic bays have less flow capacity than one-way traffic bays. Traffic in both directions is impeded by vehicles parking and vacating a space.



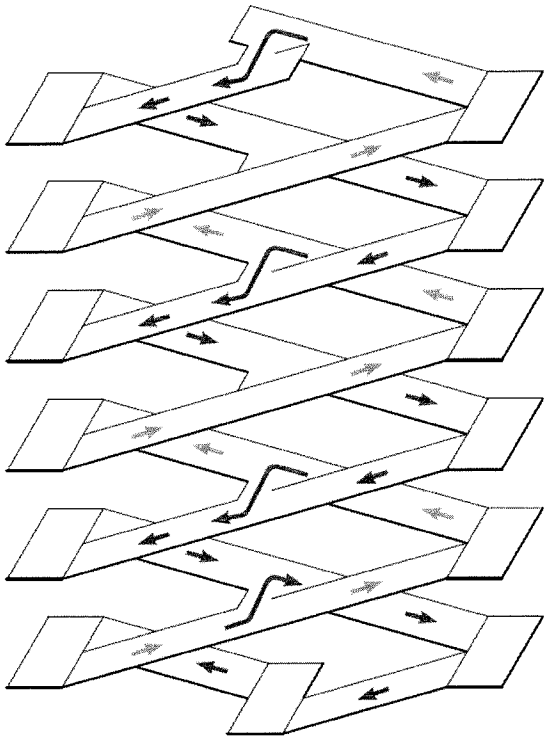
Single Threaded Helix with One Level Bay

PARKING STRUCTURE DESIGN GUIDELINES

Double Threaded Design

A facility with a one-way circulation system and angled parking can be provided in a double-threaded helix with modules ranging from 54 to 58 feet in width, depending upon the angle of parking. The preferred angles of parking for an efficient layout are 60°, 70° and 75°. A double thread, which requires a ten-foot rise along each module, requires 240 feet in length. More efficient layouts can be achieved on longer sites. The isometric right represents a two-bay double-threaded helix with one-way traffic.

A double-threaded helix can work with either one-way or two-way traffic flow, although one-way traffic is more common. A two-way double threaded design can be configured as two separate structures with no vehicular connection. A double-threaded helix rises two levels with every 360 degrees of revolution, which allows for two intertwined "threads" and the opportunity to circulate to an available parking space without passing all parking spaces as inbound and outbound traffic can be separated. Because of this, double-threaded helices are often recommended for larger facilities with seven or more levels. A two-bay double thread has a functional system capacity for up to approximately 2,000 spaces with angled parking and one-way traffic flow.



One Way Double Threaded Design

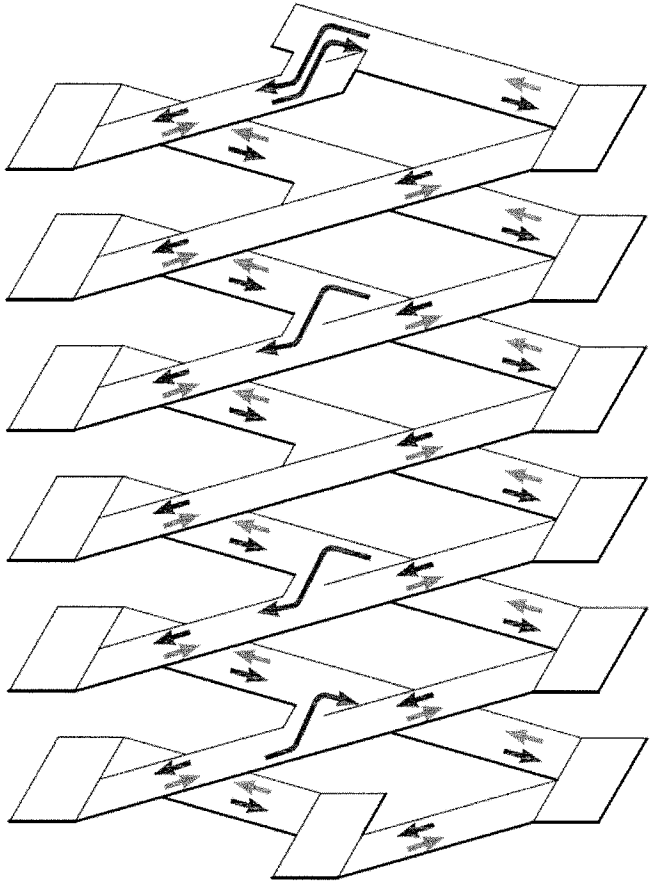
PARKING STRUCTURE DESIGN GUIDELINES

Principal Advantages of a Double-Threaded Helix:

- Efficient circulation and more traffic flow capacity
- Pass fewer spaces both inbound and outbound.

Principal Disadvantages of a Double-Threaded Helix:

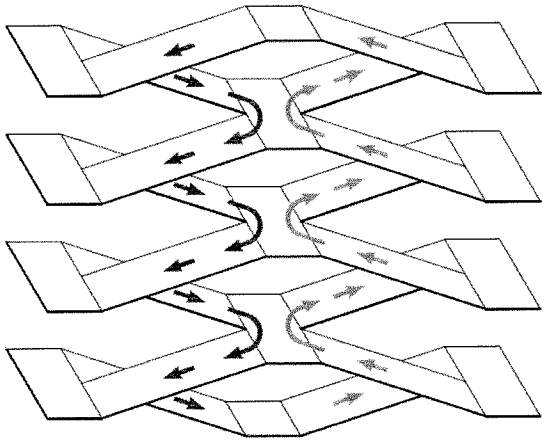
- Can be complex and confusing, particularly in finding one's vehicle upon return to the parking facility.
- Two-sloped bays and minimal flat-floor parking.



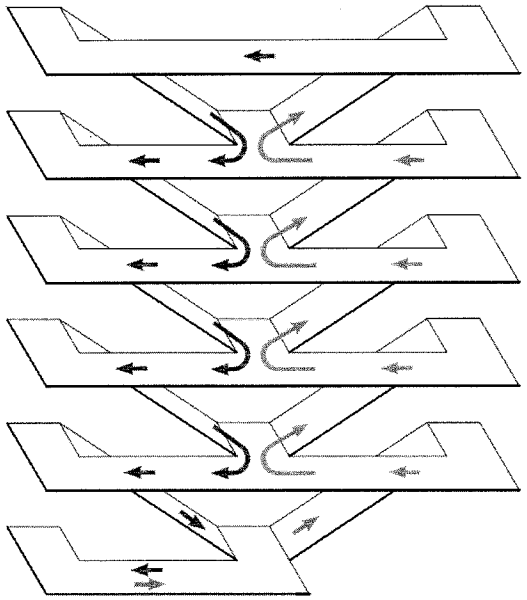
Two Way Double Threaded Design

Other Circulation Systems

There are other parking and circulation systems that are often used in parking structures.

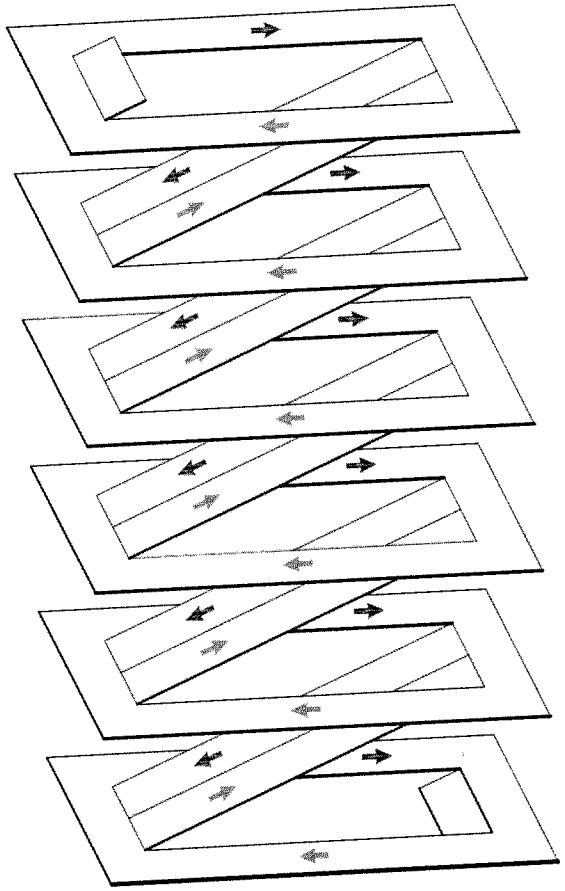


End-to-End Helix Both Bays Sloped

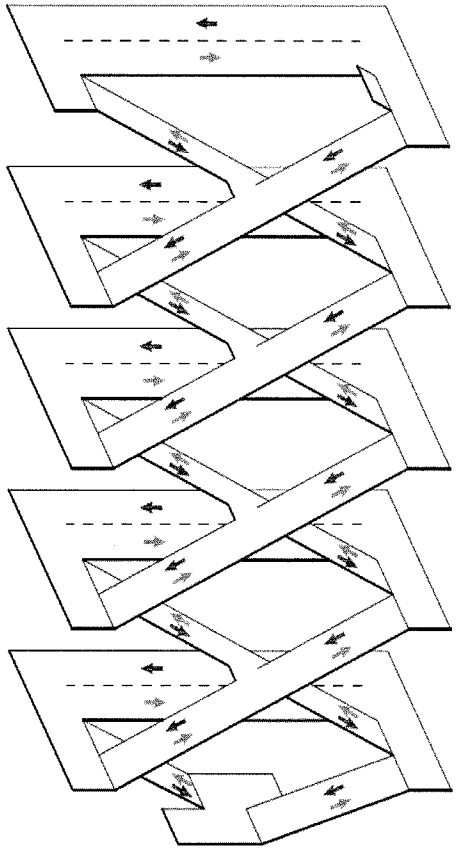


End-to-End Helix One Bay Sloped

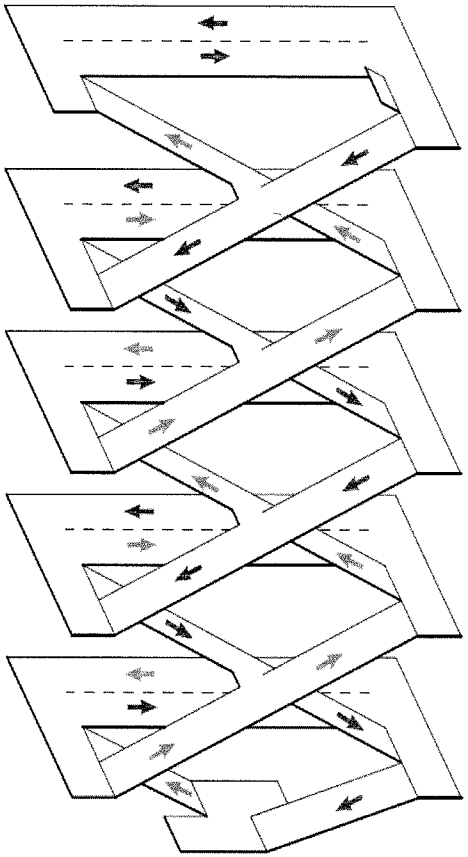
PARKING STRUCTURE DESIGN GUIDELINES



Side-by-Side Helix



Single Threaded w/ Flat Bays



Double Threaded w/ Flat Bays

Access Design

Vehicle entrances should be visible and easily identifiable. The minimum distance of entry/exits from corner intersections is at least 75 to 100 feet (preferably 150 feet). Entrances and exits should have clear lines of sight. It is preferable to enter a facility from a one-way street or by turning right from a two-way street and to exit a facility by turning right on a low-volume street. High traffic volumes and left turns can slow exiting and cause traffic backups. Consideration should be given to acceleration/deceleration lanes on busy streets. Gates should be located far enough away from the street to allow at least one vehicle behind the vehicle in the service position (at a ticket dispenser, card reader or cashier booth) without blocking the sidewalk. Entry/exit areas that have parking control equipment should have a maximum 3% slope.

It is very important to provide the appropriate number of entry/exit lanes to meet projected peak traffic volumes. The number of lanes is a function of user groups served, peak-hour traffic volumes, and service rates of the parking control equipment. It is recommended to have a parking professional prepare a lane and queuing analysis to guarantee sufficient entry and exit capacities.

Cross-traffic at entry/exits should be minimized and preferably eliminated. When placing vehicle entries and exits together on one-way streets it is preferable to avoid "English" traffic conditions where traffic keeps to the left instead of to the right. Pedestrian/vehicular conflicts should be minimized by providing a pedestrian walkway adjacent to entry/exit lanes. Stair/elevator towers should be located so pedestrians do not have to cross drive aisles on their way to primary demand generators.

PARKING STRUCTURE DESIGN GUIDELINES

Parking Geometrics

Parking geometrics refers to parking stall and drive aisle dimensions. Parking dimensions have been developed to comfortably accommodate the composite design vehicle, which refers to the dimensions of the 85th percentile vehicle in the range of vehicles from smallest (zero percentile) to largest (100th percentile). The composite design vehicle is the size of a Ford F150 truck (6'-7" x 17'-3").

The table on this page lists City of Lincoln parking geometrics by parking angle for standard and compact spaces.

Parking Angle A	Stall Width B	Curb Length Per Car C	Stall Depth D	Driveway Width E
O°	9'- 0"	23'- 0"	9'- 0"	12'- 0"
20°	9'- 0"	26'- 4"	15'- 3"	11'- 0"
30°	9'- 0"	18'- 0"	17'- 8"	11'- 0"
40°	9'- 0"	14'- 0"	19'- 6"	12'- 0"
45°	9'- 0"	12'- 9"	20'- 5"	13'- 0"
50°	9'- 0"	11'- 9"	21'- 0"	14'- 0"
60°	9'- 0"	10'- 5"	21'- 10"	16'- 0"
70°	9'- 0"	9'- 8"	21'- 10"	18'- 0"
80°	9'- 0"	9'- 2"	21'- 4"	20'- 0"
90°	9'- 0"	9'- 0"	20'- 0"	22'- 0"

MINIMUM STANDARDS FOR COMPACT VEHICLES

Parking Angle A	Stall Width B	Curb Length Per Car C	Stall Depth D	Driveway Width E
45°	7'- 6"	10'- 6"	16'- 0"	11'- 0"
60°	7'- 6"	8'- 9"	16'- 9"	14'- 0"
75°	7'- 6"	7'- 10"	16'- 4"	17'- 5"
90°	7'- 6"	7'- 6"	15'- 0"	20'- 0"

PARKING STRUCTURE DESIGN GUIDELINES

The city's parking dimensions for standard spaces exceed industry standards. The table on the following page lists parking geometrics by User Comfort Factor (UCF) which correlates with a Level of Service (LOS) approach. Traffic engineers developed the LOS approach to classify traffic conditions on roadways from A (free flow) to F (gridlock). The UCF/LOS approach has been adopted by many parking consultants to help classify conditions in parking facilities. The UCF categories for parking geometrics are as follows:

UCF 4 = LOS A = Excellent
UCF 3 = LOS B = Good
UCF 2 = LOS C = Acceptable
UCF 1 = LOS D = Poor

LOS criteria should be related to the needs and concerns of users. Generally, users with low familiarity and high turnover should be accorded a higher UCF. If the city's parking standards are not used, we recommend minimum UCF 3 geometrics for moderate to high turnover parking (visitor, retail, etc.) and UCF 2 geometrics for low turnover parking (employee, commuter, resident, etc.).

We recommend using "one-size-fits-all" parking spaces rather than segregating standard and small car spaces. However, if they are used, small car spaces should not exceed 15% to 20% of the total capacity of a facility.

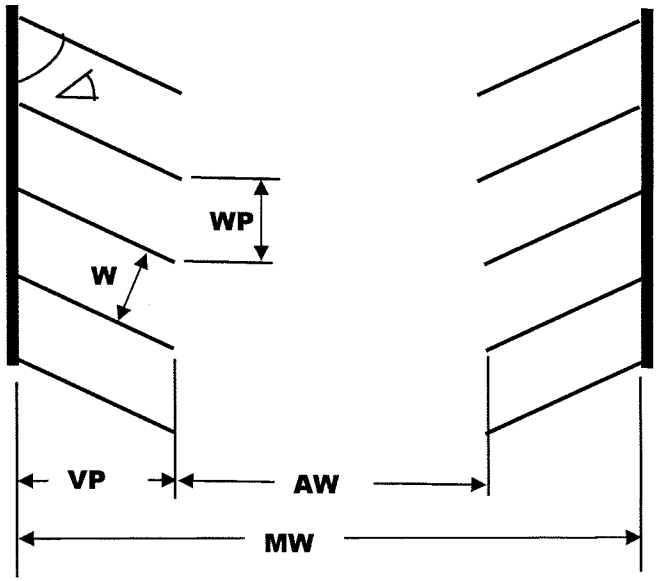
Parking Layout Dimensions

PARKING LAYOUT DIMENSIONS

Parking Angle	Stall Width Projection (WP)	Module Width (1) (MW)	Vehicle Projection (VP)	Aisle Width (AW)
User Comfort Factor 4				
		w = 9'-0"		
45	12'-9"	49'-10"	17'-7"	14'-8"
50	11'-9"	51'-7"	18'-2"	15'-3"
55	11'-0"	53'-0"	18'-8"	15'-8"
60	10'-5"	54'-6"	19'-0"	16'-6"
65	9'-11"	55'-9"	19'-2"	17'-5"
70	9'-7"	57'-0"	19'-3"	18'-6"
75	9'-4"	58'-0"	19'-1"	19'-10"
90	9'-0"	62'-0"	18'-0"	26'-0"
User Comfort Factor 3				
		w = 8'-9"		
45	12'-4"	48'-10"	17'-7"	13'-8"
50	11'-5"	50'-7"	18'-2"	14'-3"
55	10'-8"	52'-0"	18'-8"	14'-8"
60	10'-1"	53'-6"	19'-0"	15'-6"
65	9'-8"	54'-9"	19'-2"	16'-5"
70	9'-4"	56'-0"	19'-3"	17'-6"
75	9'-1"	57'-0"	19'-1"	18'-10"
90	8'-9"	61'-0"	18'-0"	25'-0"

Parking Angle	Stall Width Projection (WP)	Module Width (1) (MW)	Vehicle Projection (VP)	Aisle Width (AW)
User Comfort Factor 2				
		w = 8'-6"		
45	12'-0"	47'-10"	17'-7"	12'-8"
50	11'-1"	49'-7"	18'-2"	13'-3"
55	10'-5"	51'-0"	18'-8"	13'-8"
60	9'-10"	52'-6"	19'-0"	14'-6"
65	9'-5"	53'-9"	19'-2"	15'-5"
70	9'-1"	55'-0"	19'-3"	16'-6"
75	8'-10"	56'-0"	19'-1"	17'-10"
90	8'-6"	60'-0"	18'-0"	24'-0"
User Comfort Factor 1				
		w = 8'-3"		
45	11'-8"	46'-10"	17'-7"	11'-8"
50	10'-9"	48'-7"	18'-2"	12'-3"
55	10'-1"	50'-0"	18'-8"	12'-8"
60	9'-6"	51'-6"	19'-0"	13'-6"
65	9'-1"	52'-9"	19'-2"	14'-5"
70	8'-9"	54'-0"	19'-3"	15'-6"
75	8'-6"	55'-0"	19'-1"	16'-10"
90	8'-3"	59'-0"	18'-0"	23'-0"

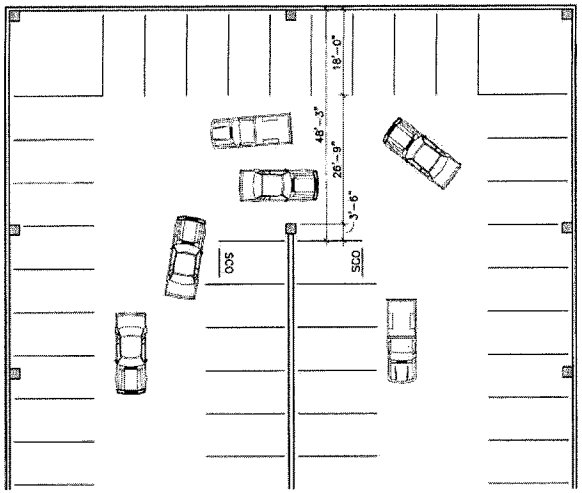
Note: (1) Wall to wall, double loaded aisle.



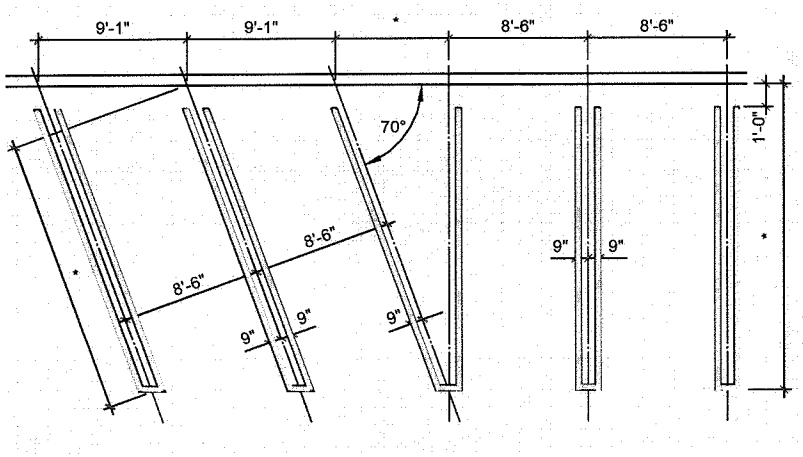
PARKING STRUCTURE DESIGN GUIDELINES

Parking spaces adjacent to walls, columns, elevators, stairs, etc. should be widened, if possible, by one foot so that vehicle doors can be more easily opened.

End bay drive aisles with two-way traffic should be a minimum of 26' wide for improved turning maneuverability. Wider end bay drive aisles are recommended for high turnover parking facilities. If possible, it is also suggested for more comfortable turns to hold back the first stall on either side of the turning bay. Small-Car-Only (SCO) spaces are also recommended at the ends of interior parking rows. It is very difficult to make a turn around only one row of parking. Refer to the following graphic.



Double stripes for space striping are recommended as they help parkers center their vehicles between stripes, maximizing the space between vehicles (refer to the graphic below). Also recommended is the use of traffic yellow paint for stall striping as yellow paint is more visible over time than white paint.



PARKING STRUCTURE DESIGN GUIDELINES

Parking Layout Efficiency

Parking Efficiency is expressed in square feet of construction per parking space. Parking efficiency directly correlates with the construction cost per space. Build less structure per space and the cost per space drops. Non-parking speed ramps for example increase the square feet per space.

Parking efficiency should be calculated considering the total parking structure size including the stairs and elevators and non-parking ramps. Any retail space that is incorporated within the structure is also usually included in the calculation.

Typical ranges of parking structure efficiencies are:

- Short Span Structural System = 330 to 390 Square Feet per Space
- Long Span Structural System = 300 to 340 Square Feet per Space
- Mixed Use Developments with retail, Residential and Parking can be as high as 400 + Square Feet per Space

PARKING EFFICIENCY MAKES A BIG DIFFERENCE – EXAMPLE

- 360 sf / space X 500 spaces X $45 / sf = $8,100,000
- 330 sf / space X 500 spaces X $45 / sf = $7,425,000

A difference of $675,000 or $1,350 per space!

Vehicular Entrance and Exit Lanes

- The number of entry and exit lanes depends on the expected peak volume of traffic and the rate of flow through the lane. The rate of flow varies depending on the type of access / revenue control equipment.
- The approach and the departure area from the lanes will also affect the rate of flow into or out of the structure. Tight turns equal a slower throughput.
- Pedestrian safety at entry and exit portals is paramount. Consider the vision cone of drivers entering or exiting the facility.
- Check and recheck with vehicle turning radii at all entry / exit lanes and adjacent ramps.

Pedestrian Requirements

Pedestrian traffic is equally as important in a parking structure as vehicle traffic. A safe, secure and well signed pedestrian path must be provided. Pedestrian access at the grade level should be separated from vehicular ingress and egress. Pedestrian access is usually adjacent to stair/elevator towers. It is also desirable to place a dedicated pedestrian aisle adjacent to a vehicle entry/exit because pedestrians are naturally attracted to these openings. Access locations should be restricted to a few locations for security reasons.

A minimum of two stairs are required to meet code-required means of egress for fire exits in parking structures. Stairs should be open or glass enclosed for security reasons. The minimum stair width in parking structures is 44" and wider stairs are required for special events. Travel distance between exit stairs is specified in the IBC and is maximum 300 feet without a sprinkler system and 400 feet with a sprinkler system. Stairs are usually placed in dead corners so no parking spaces are lost.

Elevators should be located at terminus in the direction of pedestrian travel. Hydraulic elevators can be used for up to 5 levels or 50' to 60'. Traction elevators should be used beyond 5 levels. The minimum capacity and size is 3,500 lbs. and 5'-0" x 7'-0". The number of elevators is based on the number of spaces, the number of levels, user group(s) served, peak-hour flow rates, and the size and capacity of the elevator. A parking consultant can provide a preliminary indication of the number of elevators based on a formula that takes into account the information presented above. Ornate or high maintenance elevator finishes are discouraged. **We highly recommend that elevators have glass backs for security reasons.** Enclosed lobbies are recommended for protection from the elements on the top level.

Accessible Parking Requirements

The following table presents the required number of accessible parking spaces based on the total number of spaces provided in any given facility.

The accessible parking requirement for an institution like a hospital campus is not based on the total parking capacity but rather on the capacities of the individual facilities within a parking system, which always results in the provision of more accessible spaces overall. Accessible spaces for the institution do not have to be provided in each parking area, but can be supplied at a different location provided at least equivalent accessibility in terms of distance, cost, and convenience is provided.

All accessible spaces are 8' wide with either a 5' or 8' access aisle. An accessible space and access aisle cannot be placed at a location with a running or cross slope greater than 1:50 (2%).

The current 1 to 8 ratio for the provision of van accessible spaces is changing to 1 to 6, and it is required to round up to the nearest whole number when determining the number of van spaces. The barrier free section of the International Building Code (IBC) has the same requirement. It is recommended to use the new 1 to 6 ratio when determining the number of van spaces. Van accessible spaces require minimum 8'-2" vertical clearance and have 8'-0" wide access aisles.

Each accessible space must have a sign showing the international symbol of accessibility mounted at least five feet above the pavement. All van accessible spaces must have an additional "Van Accessible" sign mounted below the symbol of accessibility (mount minimum of 5' above pavement with other sign above).

Required Accessible Spaces	
Total Spaces in Facility	**Minimum Accessible Spaces**
1 to 25	1
26 to 50	2
51 to 75	3
76 to 100	4
101 to 150	5
151 to 200	6
201 to 300	7
301 to 400	8
401 to 500	9
501 to 1,000	2% of total
1,001 and over	20 plus 1 for each 100 over 1,000

ADA requires rounding up to the next whole number when calculating the required number of spaces based on a percentage or ratio. For example, a parking facility with 810 spaces will have 17 accessible spaces (810 x .02 = 16.2 = 17 spaces), and 3 spaces will have to be van accessible (17 ÷ 8 = 2.125 = 3).

Accessible stalls cannot share access aisles when the parking is angled. Access aisles for van spaces must be on the passenger side when the parking is angled because vehicles cannot back into these spaces.

All accessible spaces must have an accessible route to public streets or sidewalks, accessible elevators, or accessible building entrances. An accessible route must have a minimum unobstructed width of 3'. A vehicle way (drive aisle) may be part of an accessible route, although it is preferred to place the accessible route at the front of the stalls. An accessible route can only pass behind other accessible spaces. It is permitted to cross a vehicle way with an accessible route.

The running slope along an accessible route cannot exceed 1:20 (5%) and the cross slope cannot exceed 1:50 (2%).

It is recommended to cross hatch all access aisles and accessible routes.

Safety and Security

Because curbs can be a potential tripping hazard, curbs in all pedestrian areas (at the end of parking rows, around stairs and elevators, dead corners, etc.) are strongly discouraged. The faces and edge of curbs that remain should be painted traffic yellow to enhance visibility.

Glass-backed elevators and glass enclosed and/or open stairways for enhanced security are recommended.

Lighting that enables users to see and be seen is one of the most important security features of a parking structure. A separate discussion on lighting is included in these guidelines.

Other important aspects of security design:

- Short span construction is not recommended.
- Security fencing at the ground level should not be climbable.
- Landscaping should not provide hiding places.
- Security cameras are a deterrent to criminal activity.
- Panic alarms and two-way communication systems are recommended in prominent locations on each level.

In general, assure that as much openness as possible is provided in the design to improve sight lines, eliminate hiding places, and enhance perceived security.

PARKING STRUCTURE DESIGN GUIDELINES

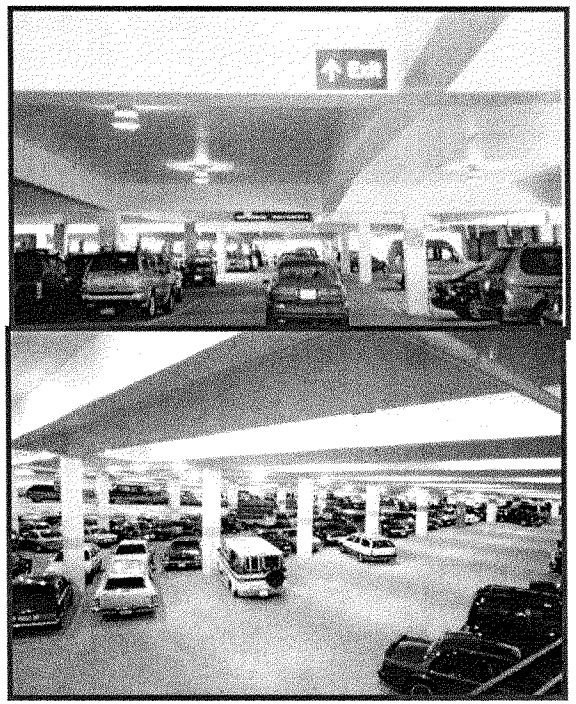
Lighting

- Key Security Measure
- Enhances User Comfort & Perception of Safety
- Business Attraction Amenity
- Permit Safe Movement for Pedestrians and Vehicles
- Enhances Signage Visibility
- Typically Light Levels Are Not Code Regulated
  - Except Emergency Lighting @ 1 footcandles Minimum
- Industry Standards
  - Illuminating Engineering Society of North America (IESNA)
  - They Publish Minimum Standards
  - Liability Risk for Non-Compliance

The recommended lighting standards listed in the table below, slightly exceed the Illuminating Engineering Society of North America (IES) lighting standards for parking facilities. Staining the ceilings white to enhance light levels is suggested.

Recommended Parking Structure Lighting Standards

Areas	Minimum Horizontal Illuminance on Floor Footcandles	Minimum Vertical Illuminance at 5 feet Footcandles	Maximum to Minimum Uniformity Ratio
General Parking & Pedestrian	2	1	10:1
Ramps and Corners			
Days	2	1	10:1
Nights	1	0.5	10:1
Entrance Areas			
Days	50	25	10:1
Nights	1	0.5	10:1
Stairways	7 avg.		10:1



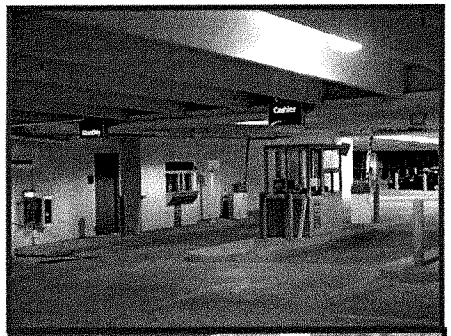
PARKING STRUCTURE DESIGN GUIDELINES

Lighting Entry and Exit Lanes

- Provide Additional Lighting (50 fc) for 10'- 60' Zone From Building Edge (Transitional lighting)
- Include Daylight Infiltration (> 15 fc)
- Typically 10' X 10' Spacing of 150 W Fixtures
- Turn 2/3 of Fixtures Off @ Night

Light Source Types

- **High Pressure Sodium**
  - Golden White HPS Light Color
  - Common Parking Structure Lighting
  - Lamp Life = 24,000-28,500 Hours
- **Metal Halide**
  - White Light Color
  - Perceived Greater Brightness
  - Lamp Life = 15,000 Hours
  - Operating Cost Slightly > HPS
- **Light Emitting Diode (LED)**
  - Emerging Technology
  - Energy Efficient
  - Long Life
- **Fluorescent**
  - White Light Color
  - New Technology – Use in Cold Climates
    - Cold Weather Ballast (If Temps < 50° F)
    - Phosphor Coating
    - Sealed Fixtures
  - Lamp Life = 30,000 Hours
  - Energy Cost Effective
- **Induction Lighting**
  - White Light – Best color rendition
  - Instant Ignition Long Life Bulbs = 100,000 Hours
  - Energy Efficient
  - High Initial Costs



Lighting Expense Reduction Strategies

We recommend that the exterior bay lighting of "open" parking structures as well as roof top lighting be on separate circuits so that these lights can be turned off during the day to reduce energy consumption/costs as depicted in the lower picture on the right.

PARKING STRUCTURE DESIGN GUIDELINES

Before and after photographs showing the results of new lighting (high pressure sodium to metal halide) and staining of ceilings

Signage and Wayfinding

Parking facilities can be very large, complex, and confusing. A well-designed graphics and signage system will effectively communicate necessary information to patrons, reduce confusion, improve safety, and enhance the overall user experience.

Sign messages should be simple and succinct. Messages on signs that are to be read quickly, such as vehicular signs, should be no more than 30 characters and six words in length. The typeface used should be simple and easy to read, and there is a general preference for Helvetica medium in the parking industry. Signs with lower case letters and initial caps are most easily read. The simple block arrow is recommended for parking signs. If a left turn is required, the arrow should be placed on the left side of the sign. The opposite is true for a right turn.

In parking structures, signs with a dark background and white letters are more easily read than signs with a white background and dark letters. The opposite is true in surface lots, where signs with white background and dark letters are better.

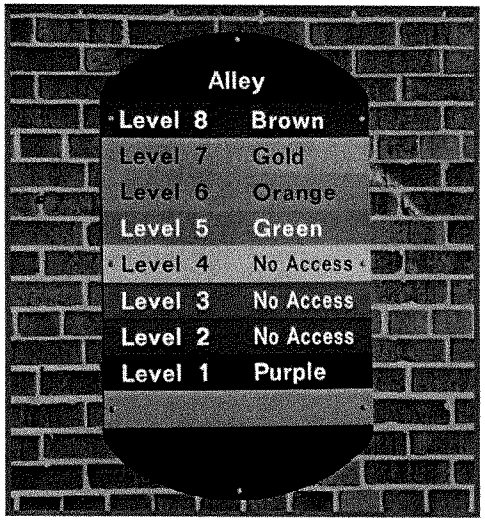
Vehicle Signs

Examples of vehicular signs include "Park" and "Exit" directional signs. Vehicular signs are ten or twelve inches in height with six or seven inch letters. Ten-inch signs are recommended for precast structures where sign visibility can be a problem. Vehicular signs should be centered over the drive lane or centered over the drive aisle when signs are mounted back-to-back.

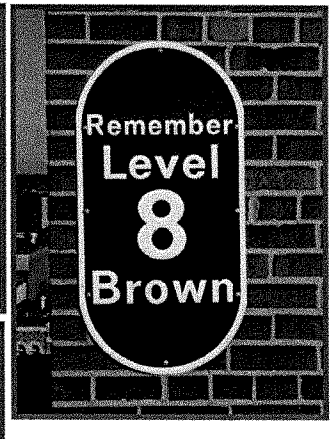
PARKING STRUCTURE DESIGN GUIDELINES

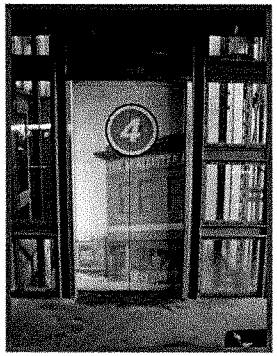
Pedestrian Signs

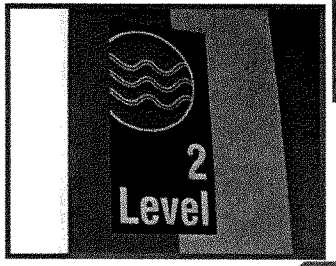
Examples of pedestrian signs include "Level #," "Remember Level #," "Row #,"and "Stair" and "Elevator" identification and directional signs. Pedestrian signs can be all one color or be color-coded by level. Pedestrian signs should be clearly distinguishable from vehicle signs so as not to interfere with vehicular traffic. Pedestrian signs in parking bays are most effective if located perpendicular to traffic flow, and they should be placed at the rear of parking stalls. Color-coding is often used to help patrons find their vehicles. It is not necessary to provide color-coding in parking facilities that are three levels or less. When color coding, it is recommended to use primary and secondary colors including red, blue, yellow, orange, purple, and green. If there are more than six levels that need to be color-coded, it is recommended to use white, brown, and black. Confusing colors such as turquoise (blue or green?) and taupe (brown, tan, or gray?) should be avoided.



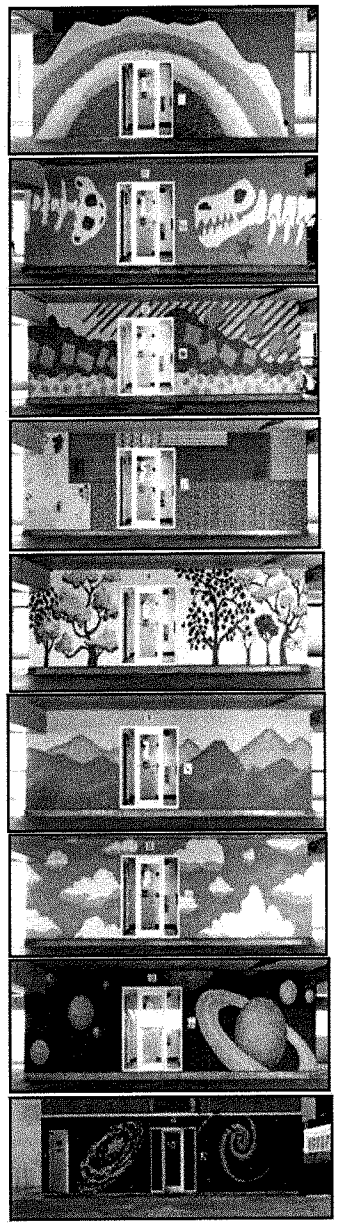
The elevator core area provides an excellent location to utilize super graphics. Super graphics is defined as a graphic that covers a large area and is generally painted on a vertical surface, such as painted walls or elevator doors, with level designation incorporated.





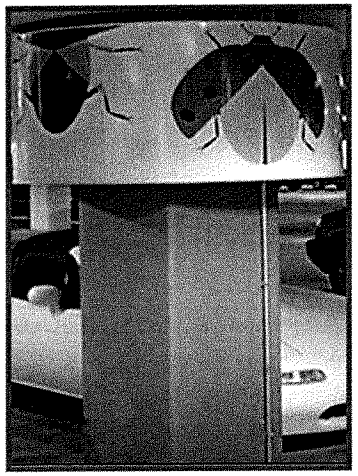


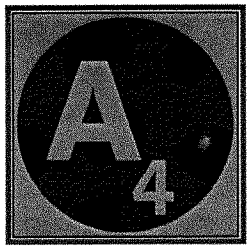
PARKING STRUCTURE DESIGN GUIDELINES

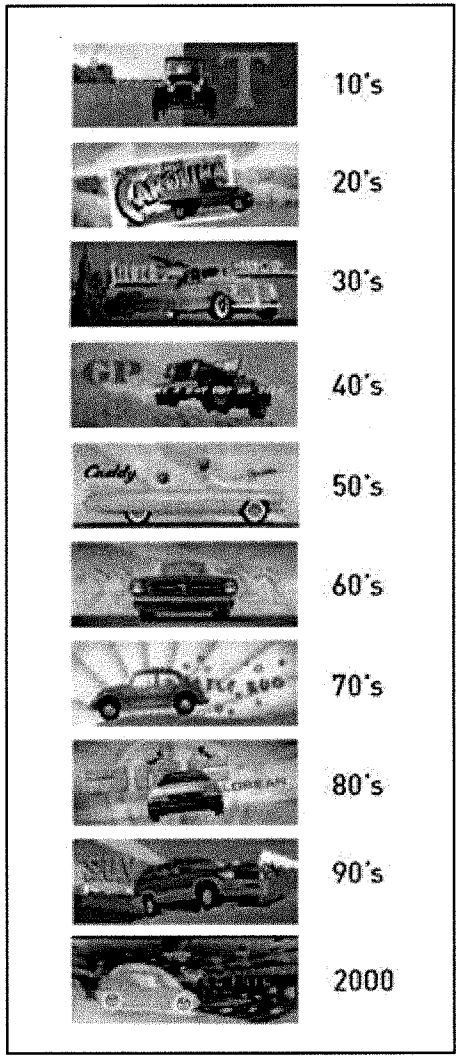


Level Theming

"Level Identification Theming" and other wayfinding aids provides an opportunity to enhance parking interior environment enhancement while also providing a practical tools to assist patrons in remembering where they parked. Several creative examples or illustrated below.



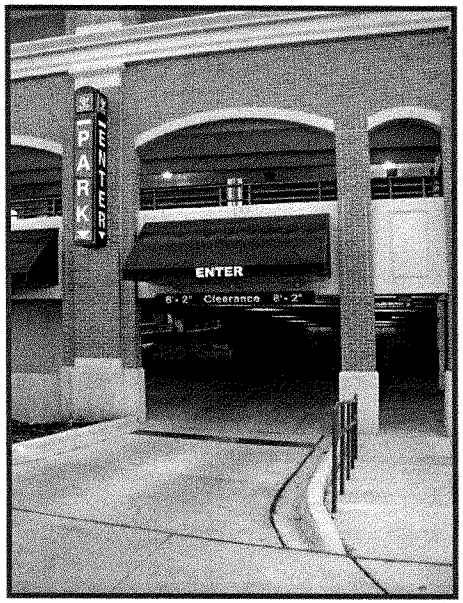




PARKING STRUCTURE DESIGN GUIDELINES

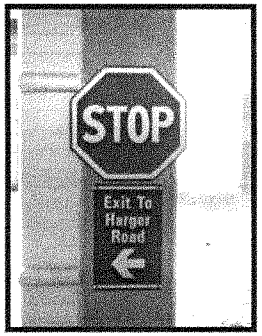
Entry Signs

Emphasizing the entrance to a parking facility is important. Large illuminated signs are often used to emphasize the facility entry and attract patrons. These signs often spell out "Parking" or use the International symbol for parking. Architectural features, such as an arch, canopy, or some different treatment of the façade, are often used to highlight the entry area as well. A height clearance bar is required for all parking structures, including the top (surface) level of below-grade facilities to prohibit over-height vehicles. Generally, the height clearance bar is located at the facility entrance(s). There may be instances when the clear height in a parking structure changes from one level to another (for example, a higher ground level than typical level to accommodate ADA vans), which may require additional height clearance bars within the facility itself. Generally, the height clearance bar is an eight-inch PVC pipe.



Regulatory Signs

Regulatory signs are often used in parking facilities. Examples include "STOP," "YIELD," "ONE WAY," "NO PARKING" "DO NOT ENTER," and accessible parking signs. When used it is imperative that they comply with local and federal requirements. The Manual of Uniform Traffic Control Devices (MUTCD) provides examples of standard highway signs.



Illuminated Signs

Illuminated signs are becoming more and more common in parking facilities. Technology has advanced significantly in recent years and illuminated signs have become more reliable. Generally, illuminated signs are used for the following parking applications:

- Entry and Exit Lanes (Open in green/Closed in red)
- Facility Full Signs
- Stop (red)/Go (green)
- Level Space Capacity
- Directional Control
- Fee Display
- Space Count Systems
- Variable Message Signs

Pavement Markings

Pavement makings should conform to Manual of Uniform Traffic Control Devices (MUTCD) or local standards. MUTCD specifies that white paint be used for markings for traffic flow in the same direction and yellow paint used for traffic flow in opposite directions, which implies a warning.

Pavement markings can be an effective way to direct and control traffic flow in a parking facility. However, pavement markings must be re-applied due to wear and deterioration from vehicular traffic. Pavement arrows may enhance traffic flow. They are often utilized on surface lots or the top level of parking structures where overhead directional signage is not possible. Traffic arrows are also commonly used in facilities with a combination of one-way and two-way traffic flow.

Drainage

Proper floor drainage is essential for all types of parking structures in all climates. While direct rain or snow may not enter all areas of the parking garage, windblown rain and snow and/or vehicles carrying ice, snow and water will distribute water throughout the facility. Heavy rains will also overload top floor drains and water will run down the ramped floors to lower levels. In addition, the frequent floor wash downs that should be part of a good maintenance program are a source of water throughout the parking facility. If the floor is not adequately sloped, water is allowed to pond and deterioration will accelerate beneath the ponds.

A design slope of 2%, or ¼ inch per foot, is desired, with a minimum design slope of 1-½%. Water should be drained away from exterior columns/walls and pedestrian paths. Washes may be needed in slab corners to achieve drainage slopes.

Floor drain locations are determined by the circulation system, number of bays, and structural system. The top level drain system should be designed to accept a 10-year design rainfall or as required by local code. Three to four inch piping is generally used on covered levels.

PARKING STRUCTURE DESIGN GUIDELINES

Open or Enclosed Parking Structure

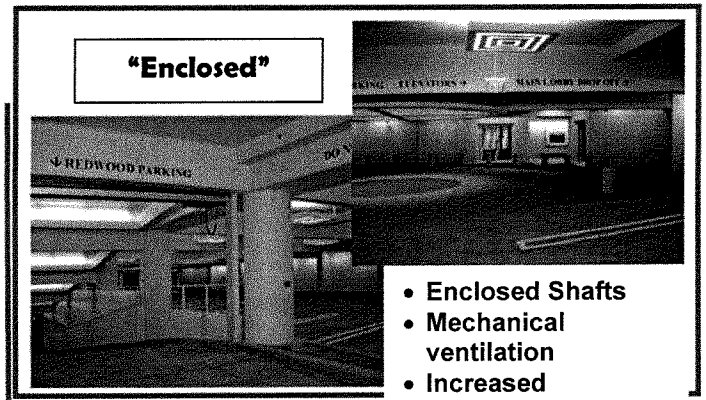
Natural ventilation requires openings in exterior walls of sufficient size distributed in such a way that fresh air will enter the facility to disperse and displace contaminated air. The 2003 and 2006 International Building Code (IBC) states:

> *"For natural ventilation purposes, the exterior side of the structure shall have uniformly distributed openings on two or more sides. The area of such openings in exterior walls on a tier must be at least 20 percent of the total perimeter wall area of each tier. The aggregate length of the openings considered to be providing natural ventilation shall constitute a minimum of 40 percent of the perimeter of the tier. Interior walls shall be at least 20 percent open with uniformly distributed openings."*
>
> *"Exception: Openings are not required to be distributed over 40 percent of the building perimeter where the required openings are uniformly distributed over two opposing sides of the building."*

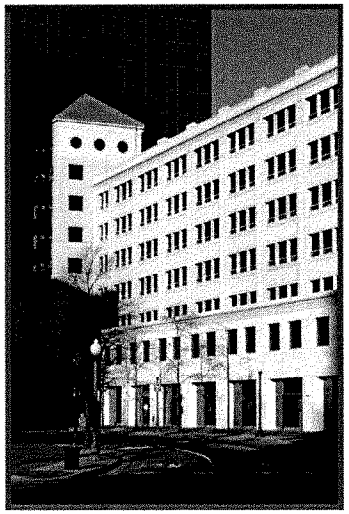
Setbacks can affect openness as firewalls are required if certain distance requirements from property lines and other buildings are not maintained. Parking structures are typically classified as enclosed if other uses (retail, office, residential) are located above the parking, but may remain open if parking is above or adjacent other uses. When a parking structure is positioned below grade, areaways can be used to achieve natural ventilation. The building code addresses the geometry required to permit acceptance of an areaway.

Parking structures classified as "open" do not require mechanical ventilation, fire suppression (sprinklers), and enclosed stairs.

"Enclosed"



- **Enclosed Shafts**
- **Mechanical ventilation**
- **Increased illumination**
- **Increased fire rating**
- **Fire sprinklers**



"Open"

- **"Open" structures are allowed much larger floor plates and many more levels**
- **"Open" structures are naturally ventilated, so do not usually need mechanical ventilation**
- **"Open" structures do not require stairs to be enclosed**
- **"Open" structures allow a lot of natural light**

PARKING STRUCTURE DESIGN GUIDELINES

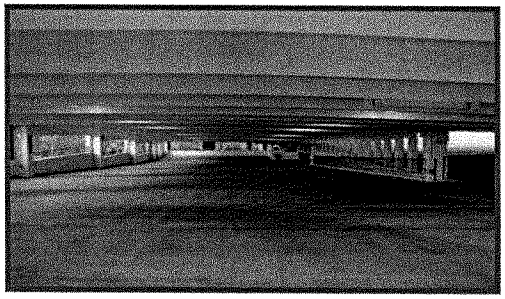
Structural Systems

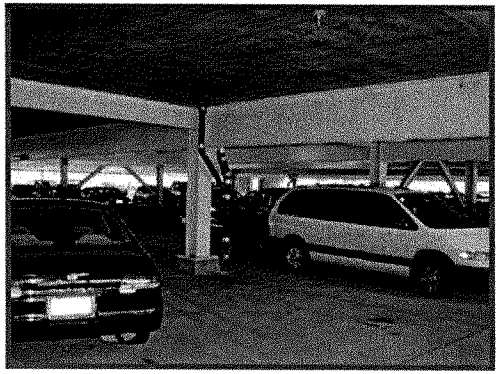
Following are the advantages and disadvantages of the three primary structural systems commonly used in parking structures today:

- ***Cast-in-Place Concrete***
- ***Precast Concrete***
- ***Steel Framed***

The selection of the structural system should be given careful consideration. The decision is often made based on the following:

- Owner preference
- Design team preference
- Schedule
- Construction budget
- Openness and perceived headroom
- Owner's tolerance and budget for maintenance
- Local availability of product and labor





PARKING STRUCTURE DESIGN GUIDELINES

Cast-in-Place Concrete

Advantages of Cast-in-Place Construction:

- Monolithic construction so fewer sealant joints
- Positive drainage is easier to achieve
- Post-Tensioning forces reduces slab cracking
- Floor vibration imperceptible
- Flexible column spacing (20' to 27')
- Generally no shear walls
- Lower maintenance cost
- Wide beam spacing creates more open feeling with perception of higher ceiling
- Accommodates parking structures on irregular sites, beneath buildings, and underground

Disadvantages of Cast-in-Place Construction:

- Potentially higher construction cost
- Quality control is more difficult to attain due to exposed weather conditions
- May require architectural cladding to improve exterior aesthetics
- Less adaptable to winter construction in cold climates
- Longer on-site construction schedule
- Closer expansion joint spacing
- Congestion of tendons and rebar at beam column joints
- Larger on-site staging requirement

PARKING STRUCTURE DESIGN GUIDELINES

Precast Concrete

Advantages of Pre-Cast Construction:

- Quality control because members are fabricated at a plant
- Potentially lower construction cost in some regions
- Shorter on-site construction schedule
- Greater expansion joint spacing (up to 300 feet)
- More adaptable to winter construction
- Architectural façade spandrels also serve as structural load bearing elements

Disadvantages of Pre-Cast Construction:

- More propensity for leaking at the joints
- Higher maintenance cost for sealants
- The close spacing of thee tee stems creates the perception of lower ceiling height
- Tee stems can block signage and interfere with lighting distribution
- Shear walls affect architecture at the exterior and reduce visibility at the interior
- Reduced drainage slopes
- More bird roosting ledges
- Might not be performed by local subcontractors

PARKING STRUCTURE DESIGN GUIDELINES

Steel Framed

Advantages of Steel Construction:

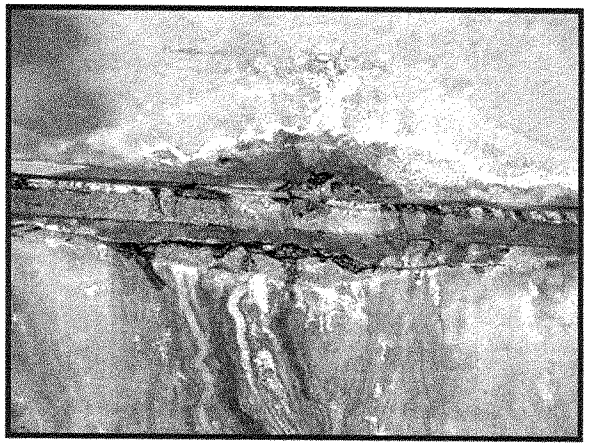
- Flexible column spacing of 18' to 22'
- Generally no shear walls
- Can be performed by local subcontractors
- Shorter on-site construction schedule
- Potentially lower construction cost
- Easily accommodates vertical expansion

Disadvantages of Steel Construction:

- Erection concerns due to mixing foundation, steel, and precast subcontractors
- Not recommended where the steel is required to be fire rated by the building code
- Depending upon code requirements, steel structure may need to be fireproofed
- Steel painting for corrosion protection
- Maintenance of steel paint system
- Steel delivery times can fluctuate
- Extensive bird roosting ledges on the beam flanges

Durability Design

It is recommended to perform an analysis in the schematic design phase to determine which durability elements should be included in the design of a parking structure. These elements include sealers, deck coatings, concrete additives, corrosion inhibitors, and epoxy coated reinforcement. Durable parking structures also require quality concrete (low water-to-cement ratio), adequate concrete cover, proper concrete curing, and good drainage. Tradeoffs between initial costs and long-term maintenance costs should be considered. Enhanced durability systems should be provided in areas with severe exposure, such as supported structure near vehicular entries and snow storage areas on the roof level. Deck coatings (membrane) are recommended over occupied space and over electrical and storage rooms.

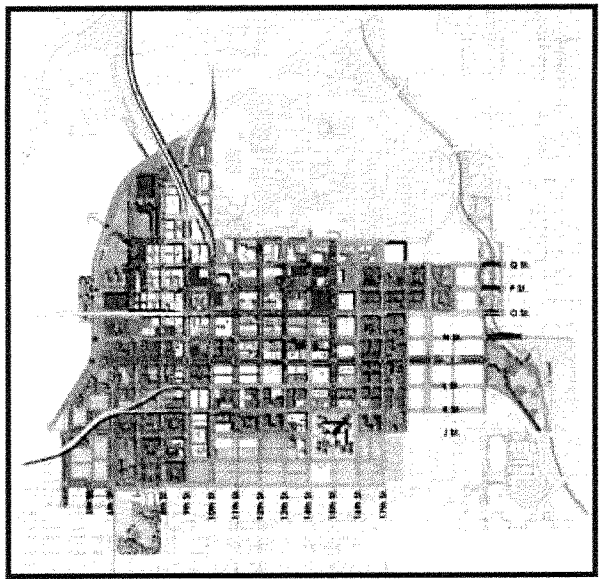


The design of a parking structure should at a minimum conform to the intent of American Concrete Institute's Guide for the Design of Durable Parking Structures (ACI 362). The design life of a parking structure should be 60 years.

Other Considerations

There are other aspects of parking structure design that will not be specifically addressed but should be kept in mind, including:

- Zoning Requirements (permitted uses, setbacks, easements, etc.)
- Building Code Compliance
- Subsurface Conditions and Foundations
- Aesthetics
- Fire Rating, Fire Protection and Life Safety
- Mechanical Systems
- Storm Drainage and Water Storage
- Parking Access and Revenue Control Equipment
- Mixed Uses (retail, residential and office)
- Parking Office Requirements
- Maintenance



Parking Facilities

by Shannon Sanders McDonald, AIA(http://www.aia.org)
Last updated: 02-16-2015

OVERVIEW

Parking as part of an overall transportation system is one of the crucial issues of our times. As the number of automobiles increases exponentially around the world, the need to house them in close proximity to destinations creates a challenging design problem. The parking facility or lot must foremost deal with the Functional/Operational(func_oper.php)—as in providing for safe and efficient passage of the automobile and driver. This is a very complex challenge as automotive, engineering and traffic issues relative to site locations must be integrated to create the appropriate solution. Therefore designing the parking facility requires an integrated design approach(/wbdg_approach.php) of many professionals. Parking has often been reduced to the construction of the most minimal stand-alone structure or parking lot without human, aesthetic(aesthetics.php) or integrative considerations. This has given parking a poor public perception and has frequently disrupted existing urban fabric. However, many architects, engineers, and planners have envisioned and constructed far more complex, aesthetic, and integrative structures. This should be the goal of good parking design.

BUILDING ATTRIBUTES

The Wave Mixed-Use Facility, Atlantic City, NJ: A part of the Atlantic City redevelopment effort.
(Photo provided by Timothy Haahs and Associates)

Although parking facilities can take many forms as stand-alone or part of a mixed-use structure, self-park or valet, and automated in urban settings, all parking facilities should seek to meet the following basic criteria:

Planning

Planning for parking facilities is a complex activity that requires the collaboration of many professionals for a successful outcome. Planning for the integration of parking in the urban environment must first start with the consideration(/ccb/browse_doc.php?d=8157) of site(/resources/lidsitedesign.php). Transit Villages, Smart Growth and New Urbanist planning strategies are becoming popular and are being built in greater frequency around the county. They each address the movement and storage of cars in various ways that combine residential use with many other building types and other forms of transportation.

The Delancey Garage (Michielli + Wyetzner Architects)

Submitted by
S. Overby

Functional Requirements

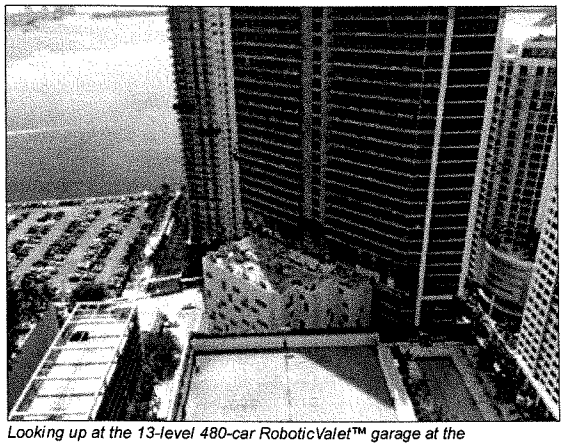
The facility should account for the complex spatial needs(account_spatial.php) of the driver and the automobile:

- The size, height, and turning radius of current automobiles as well as past and future trends of automobile size and statistical quantity must be taken into account these are called parking geometries.
- There are many ramp design configurations and different ones are appropriate for the primary purpose of the facility to insure that your intended use is compatible with ramp design.
- The streets surrounding the facility and their traffic flow must be taken into consideration when planning entrances and exits and deciding on ramp designs.
- The entrances and exits are very important to the smooth functioning of the facility, with the type of use again determining the length from the opening and placement of the entry booths, as well as the quantity of entrances and exits.
- The type of equipment and the necessity of a booth and office are also determined by the facility use.
- Zoning issues require the number of spaces for parked automobiles. The designer must work within local codes to meet these requirements.
- In mixed-use projects there has been shared parking documenting how different users can maintain full facility occupancy, such as movie/theater goers, night use and residential use during the day. This can be calculated to the advantage of the facility owner and the community by eliminating the empty night facility syndrome.
- Optimizing site potential(site_potential.php), by choice of site and its relationship to walking, driving, other transportation linkages and good design opportunities.
- The operation and maintenance of a facility is very critical. Revenue control equipment and other issues related to the smooth functioning of the garage must be taken into account during the design process.
- Provide for appropriate work space for the staff, such as cashier and monitoring equipment.
- Provide an area or room for the storage and maintenance issues. This area should be heated/air-conditioned and contain a mop sink.
- Accommodate technological tools(integrate_tools.php) for future upgrades of operational systems and facility expansion.
- Plan for a back up power system.
- Ventilation is an issue within some types and some areas of parking facility design. New technologies are increasing the effectiveness in design and monitoring of these areas for concern. Natural ventilation(/resources/naturalventilation.php?r=parking) is always a good method however detailed study is required in some areas and types of parking facility design to determine its effectiveness.
- Lighting is a crucial aspect of parking and type, placement, and quantity needs to be carefully studied to provide enough light for the users of the parking garage and not to spill out of the parking facility affecting surroundings.

Structural Integration

The efficient integration of structure is crucial to maximum functioning of the facility:

- The parking facility is typically an exposed structure and must be designed to withstand all aspects of environmental conditions.
- There are ideal structural bays that allow for maximum number of parking spaces and flow of automobiles dependent upon site and structure.
- Cast in place concrete, pre-cast concrete and structural steel can be used for the structural design.
- Typical construction issues such as natural hazards(resist_hazards.php) in the location of construction apply and compound the solutions in designing a structure that is completely exposed to the weather and constant movement from automobiles.
- Size and length of some structures compound the expansion and contraction issues already of key importance in facility design.
- The surface of the "floor" of the facility is important to slippage issues as one must always design a facility as a fully exposed building for the safe(secure_safe.php) use by both the automobile and pedestrian.
- In very cold climates ice, snow, salt and other road chemicals must be taken into consideration. Some facilities have snow chutes where snow can be plowed off of the top level of the structure. At minimum an area where snow can be piled must be designed into the structure or lot.
- Drainage and floor slope is very important, as ponding water can create long term maintenance problems.
- Peer review of the design is often used on facility documents before the construction process. Performance objectives(meet_performance.php), cost-effectiveness(cost_effective.php), and building commissioning(/project/buildingcomm.php) are useful tools.



Looking up at the 13-level 480-car RoboticValet™ garage at the Brickellhouse condominium in Miami, Florida.
(Woody Nash, Boomerang Systems, Inc. Photo: Michael J. Paddon)

Operations and Maintenance

One of the important aspects of parking facilities is their operations and maintenance. The constant use of parking facilities as an expected part of our infrastructure and as revenue generating requires unique maintenance and operational needs. Maintenance is crucial due to its complete exposure to the weather.

Maintenance requires a specific program and checklist and the frequency for maintenance (recommended and minimum). This list covers cleaning, doors and hardware, electrical, elevators, HVAC, landscaping, painting, parking control equipment, plumbing, drainage, and roofing, safety, security, signs and graphics, structural systems and waterproofing.

The long-term maintenance of the concrete especially in freeze/thaw conditions is especially important. Expansion and control joints are also an important part of this maintenance. Lighting maintenance and control for the safety of the users is also crucial.

Operations:

- Operating a parking facility requires interaction with the general public and many legal rules and regulations.
- Financing, revenue and costs are critical to its functioning as a building type.
- Employee training and proper auditing processes are vital.
- No longer a cash only process, the parking facility now embraces many forms of payment and different types of payment systems such as pay on foot.
- Often, it is owned and operated by a municipality or another entity such as an airport and all of the interrelationships and requirements between these building types and owners must be addressed.
- Transportation Demand Management is linked to parking facilities as well as traffic engineering.

Safety and Security

Safety and security(secure_safe.php) of the people using the facility are of paramount importance:

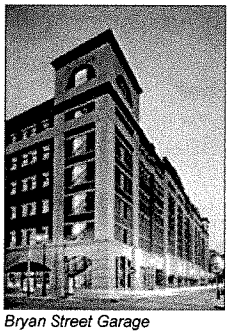
- Open, glass stairwells and glass-backed elevators.
- Security devices such as video, audio and emergency buttons that call into the booth or local police station.
- Eliminate potential hiding places, such as under open stairs.
- Handicap accessibility(accessible.php) with vehicles close to stair and elevator cores having a direct path to key movement patterns of the facility.
- To avoid carbon monoxide build-up, air flow is adequately designed for through mechanical(/resources/hvac.php?r=parking) and/or natural ventilation(/resources/naturalventilation.php?r=parking).
- Non-slip floor surface
- Cleanliness
- Design for the points of intersection between man and the automobile for adequate safety of movement.
- Energy efficient lighting(/resources/efficientlighting.php?r=parking) is very important in facility safety but can pose problems with spillage out of the facility onto neighboring communities. A balance between daylighting(/resources/daylighting.php?r=parking), interior lighting and exterior control can be addressed in many ways on the exterior design of the façade while providing adequate lighting within. Lights should be vandal resistant and easy to maintain.
- Use CPTED(http://en.wikipedia.org/wiki/Crime_prevention_through_environmental_design) (Crime Prevention Through Environmental Design) whenever appropriate along with technological equipment. (More(/resources/landscape_sitesecurity.php))
- Life safety(accommodate_needs.php) is of key importance in any built structure and the parking garage is no exception.

Signs and Wayfinding

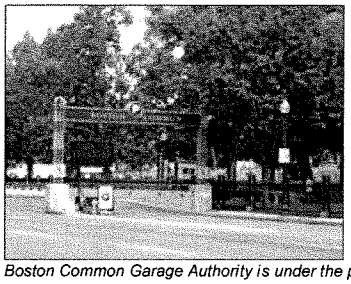
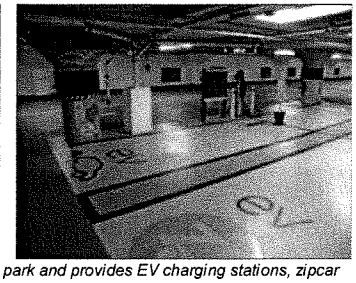
- Color-coding, numbering, visual cues, music, and even machines for marking your ticket with your exact location to locate your car for easy retrieval
- Locate signs in areas where driver can read in a timely fashion.
- Clear, simple, and direct messages.
- Floor coding can be useful
- Signage(/ccb/browse_doc.php?d=9389) should locate all major internal pedestrian access points as well as external major roads and buildings.
- Art has been used to assist with wayfinding as well as a way to enliven our everyday experience.

Aesthetics(aesthetics.php)

Aesthetics of facility design has become very important to communities across the country:


Bryan Street Garage (Courtesy of Carl Walker, Inc.)

- Recently facility design has become part of an architectural style(engage_process.php) of the surrounding architecture, respecting the language of design(respect_design.php) and using the design process.
- The historic preservation(historic_pres.php) movement was one of the key issues in facility design as facilities were needed to revitalize dense older urban fabrics without destroying the architectural context. Many excellent examples can be found across the country solving these contextual issues.
- The Parking facility itself is now also part of the historic preservation movement as some older existing structures can and should be designated for preservation.
- The Parking Facility has played an important role in design evolution throughout its history often being the leader in many crucial design issues; it is truly a unique and important civic building. Perhaps one of the most important design laboratories of the 20th century it has become the gateway to our buildings and cities.
- Maintain the urban street front by having the sidewalk condition of the facility contain stores or provide a safe and pleasant walk experience.
- Using landscaping and changes in architectural materials(/resources/materials.php?r=parking), forms(/resources/form.php?r=parking), and scales to enhance the facility façade along the street. Use landscaping to shield and enhance parking lot design.
- Architecturally breaking down the scale of the large structure along its façade.
- Designing beautiful stairs and elevator cores to enhance the community and walking experience.
- Most costly solution is to "hide" the facility by placing below ground.

Boston Common Garage Authority is under the park and provides EV charging stations, zipcar sharing (zipcar and hybrid vehicles have priority spaces), AVI readers, and so much more! (Photo provided by Massachusetts Convention Center Authority)

Integrated and Mixed-Use Design

Facilities are often connected to other uses and building types.

- The facility has always been a mixed-use structure combining and often connected with all other building types.
- Plan for any loading or unloading conditions required by mixed-use, so as not to interfere with facility traffic.
- Separate roofing and structural system for any human-occupied space within facility.

- Provide for simple and well-designed movement systems for pedestrian and automobiles.
- Many facilities are combined with almost any use imaginable such as a playing surface on the roof requiring green architecture, so enjoy the possibilities of integrating a fully functional structure requiring many technological advances.
- Surface parking lots can be designed to become mixed-use plaza spaces.
- The facility has often in its history been part of a multi-modal system linking different forms of transportation.

Environmental Issues

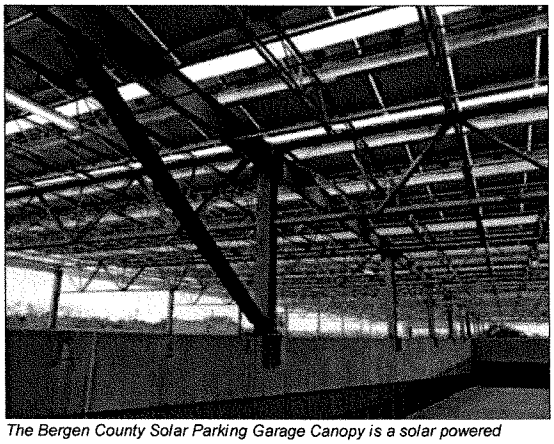
The car in its early years was the environmental savior of our cities and towns, eliminating animal waste and carcasses in our streets, part of the cause of many health and environmental hazards at the beginning of the century. But as their numbers and use have dramatically increased they have become part of the current environmental problems.

Air Pollution

New fuel sources for the automobile can eliminate air pollution hazards caused by emissions from the vehicle and automobile manufacturers are working on the solutions.

Energy

Parking lots as large areas of paved surfaces contribute to warming trends in cities and can alter local weather patterns(/ccb/browse_doc.php?d=8231). The addition of solar panels sometimes simultaneously serving as shading devices or aesthetic façade treatments can work to address multiple concerns.



The Bergen County Solar Parking Garage Canopy is a solar powered parking facility. (Photo courtesy of Stantec)

Water

Local codes can assist with addressing the amount of parking allowed(/ccb/browse_doc.php?d=9720). Paving that has absorbed oils, fuels, road salts and other materials contribute to problems in water runoff and water pollution(/resources/greenroofs.php). As well, pervious paving can provide a solution in parking lots.

Green Roofs

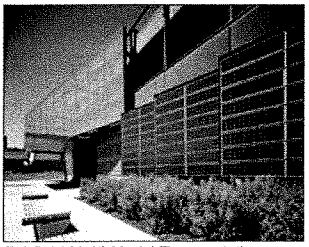
Parking facilities can address these issues in several ways, one being the green roof. The parking garage can also meet the standards of a living regenerative, and adaptive building(/resources/livingbuildings.php).

T3 Parking Structure has transparency, light from a light well within, and a green roof as part of its appeal in a residential neighborhood.
(Whit Preston, photographer and Danze Blood Architects PLLC)

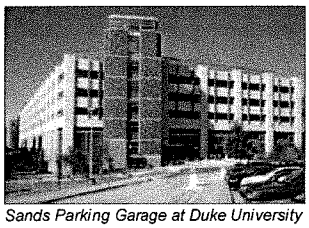
Green Globes(http://www.thegbi.org/green-globes-certification/overview/), Energy Star(http://www.energystar.gov/) and even LEED(http://www.gbci.org) are recognizing parking as part of a sustainable rating system.

The Green Parking Council(http://www.greenparkingcouncil.org/) has developed specific criteria for sustainable parking.

Sustainable Designs


Fairfield Multi-Modal Transportation Facility
(Photo by David Wakely / Courtesy Stantec Architecture)

This term discusses a set of interrelated issues that is very complex when applied to the parking facility typology. The parking facility in and of itself is a better land-use choice in attempting to create a more sustainable built environment by increasing the amount of parking within a limited land area or making the connection to other forms of transportation reducing traffic and congestion issues. The actual construction of the facility can begin to meet the LEED (Leadership in Energy and Environmental Design) Green Building Rating System® criteria and a new Federal Green Construction Guide for Specifiers(http://fedgreenspecs.wbdg.org/) will soon be available, also refer to Sustainable Design Objectives(sustainable.php). Green Building Rating System criteria and several LEED certified parking facilities are now starting to appear. New advanced material choices both in steel and concrete can contribute to the overall score while site sensitivity is also crucial. Lighting can be handled from both a passive design approach as well as technological solutions to just provide light when needed. Water conservation(/resources/water_conservation.php?r=parking), sun control shading(/resources/suncontrol.php?r=parking) and other passive devices can be integrated into parking facilities. While solar technology can also be used to handle energy needs. Also since the parking facility is such an integrative building typology many other solutions can contribute to sustainable design such as the now common for underground parking facilities; the green roof. Due to its integrative nature with other building typologies it can also help to support them in sustainable solutions designing the parking facility to become part of an energy generating solution. The parking facility has often been at the forefront of design advancements due to its ability to be transformed both inside and outside to meet changing practical needs. As the automobile and our energy sources change over the next century, a symbiotic relationship between the building, the automobile, and energy can occur, each providing energy and power to each other creating a totally sustainable solution.


Sands Parking Garage at Duke University
(©Vince Streano, 2010)

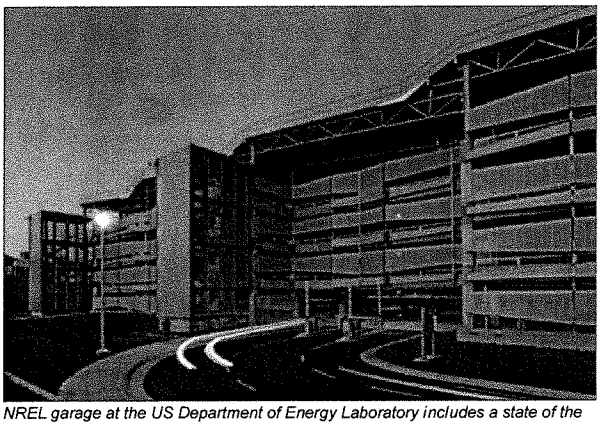
The Sands Parking Garage is a free-standing facility without any spaces for human occupation. It integrates many sustainable practices such as: two 10,000 gallon cisterns that collect rainwater for landscaping, overhead canopies that use plants to provide shade on the roof, low-power LED lights, and soon to be installed solar panels. It soon will have charging stations for electric-hybrid cars and is part of the University's overall commitment to a Climate Action Plan for the entire campus.

EMERGING ISSUES

Transportation

Parking facilities can serve an important role as a point of passage for the driver from the car to other forms of transportation due to their typical use as the first and last mile part of travel. This gateway role is often overlooked in the design process. In attempting to resolve the complex urban and environmental issues surrounding the use of the automobile in the United States, the parking facility can be seen as part of the solution for the integration of different transportation systems as a gateway or transfer point between systems, bus, train or air. These solutions are not historically new but are seeing a reemergence, as traffic in many urban areas becomes overwhelming and extremely time consuming.

Mixed Use


NREL garage at the US Department of Energy Laboratory includes a state of the art solar array. It is exposed structural and architectural steel including a center light well for natural daylighting. (Frank Ooms—photographer, courtesy of RNL Design)

Parking facilities can also combine with other building types as mixed-use structures due to their very function. Aesthetically pleasing designs as well as land use, safety and ease of use can be better accommodated with a mixed-use structure. Residential and Hospital use/facility combinations typically pose the most difficult design challenges due to fire code issues. An important emerging issue is addressing fire codes as related to mixed use when combining buildings with modern facilities. Transit Villages, Smart Growth, and New Urbanist planning strategies are becoming popular and being built in greater frequency around the county. They each address the movement and storage of cars in various ways that combine residential use with many other building types.

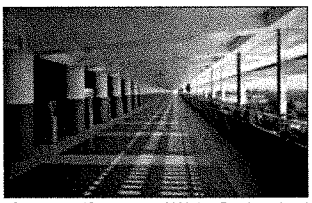
Safety

An emerging issue with safety is a threat/vulnerability assessment(/resources/riskanalysis.php?r=parking) in response to car bombings. Risk, cost, and convenience must be factored in together in determining solutions. In certain mixed-use conditions all of these factors should be considered in determining the most appropriate solutions. Technology may eventually play a role in the screening of vehicles for explosives as they enter the parking facility.

Pedestrian Access

Although safety for the pedestrian has been a recent concern in parking facility design with adequate lighting and open stairwell and elevator design, the actual movement of the

pedestrian through the facility has rarely been designed for. Several facilities are being designed to create a more pleasing environment with separate paths for the pedestrian from their cars to other circulation paths to specific points of destination. Vertical openings piercing the facility and landscape plantings within the structure are also creating a more open, safe, and inviting place to walk. By addressing the pedestrian within the facility and parking lots they can become a part of a total urban design system addressing our aging society and the important gateway issues of this type.



Left: San Mateo Government Center Parking Structure (Courtesy of Watry Design, Inc.)
Right: Disney Resort Guest Parking Structure Anaheim, California (© Disney)

Technological Changes

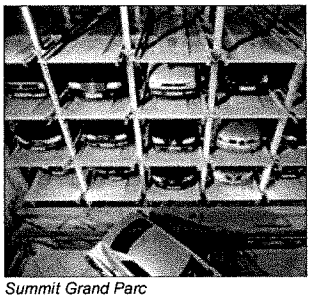
Advances in technology are changing the way we can enter and leave a facility. Technological advances in pay systems and movement access systems allow for easier flow of movement of pedestrians and automobiles. Two are AVI - Automatic Vehicle Identification systems and LPR - License Plate Recognition Systems. There are also automated systems that direct your car to the open spaces available and pay-on-foot systems eliminating the booth. Mobile connections can now occur, so that your time of arrival to the facility is anticipated and your car is ready for you to drive, fees already paid for. Technological advances are also changing the way and where we work. With many people telecommuting from home the parking facility can provide the mixed use of small office locations to connect to a main office location downtown.

Automated Mechanical Facilities

In the United States there is a long history of mechanical facilities. Starting in the 1920's and again in the 1950's mechanical facility systems were built in this country. Honolulu, Hawaii built systems in the 70's and 80's. Many automated systems have been built across the country typically in dense locations where the project and the site required an automated facility in order for the project to be a success. This type of facility is now competitive in most locations with all but the most basic ramp facility to build, however certain site and/or building type relationships allow this type of facility to be even more economically feasible. Automated facilities have many aspects that reduce cost such as they require less lighting and ventilation since they have very little human use.

There are many other advantages such as more cars per site area, no pedestrian access to the facility and few attendants. Many structural and functional types of automated mechanical systems exist: such as underground systems as part of the building foundation or above grade where they can match neighboring buildings in architectural appearance. The actual mechanisms and movement systems that carry the automobile vary with each manufacturer.

Car stackers, stand alone systems, have been frequently used in the United States, particularly in dense urban areas to expand the parking capacity of parking lots. They are now also found within parking garages to expand the capacity of a parking facility.



Summit Grand Parc
(Courtesy of Space Saver Parking Company and Mid-American Elevator Company)

Car Sharing

One idea that is taking hold is the idea of point to point use of the car. You would rent the car from home to work where it would be left in a facility to be rented by someone who can use the car during the day. The return trip home would function in the same way. Depending upon the access of these parking rental structures many point to point uses could occur. The Center for Neighborhood Technology(/references/cs_cnt.php) can offer insights into many alternative approaches.

Electric Vehicles

The very first parking facilities in the early 1900's were for electric vehicles and charging stations were designed within the facility structure. With the current changes in vehicle design, the parking facility often accommodates electric vehicle use for personal automobiles as well as for campus and other vehicles required for particular owners and users of facilities. The way that a car is powered in the future will solve environmental issues but traffic and parking concerns will remain if we as a culture continue to depend on the single occupancy vehicle. But, as the fuel source changes, the design of the car will also evolve and the way it moves through space will change with it. These design changes will have the power to modify the parking facility/building relationship. What this means to future architectural design is a place for interesting study and back to the future ideas. New experiments in alternate fuels for vehicles will also impact parking facility design. Smaller city vehicles are now entering the market, and along with the urban planning issues of designing communities as walkable integrating electric vehicles such as MIT CityCar into the transportation mix a safer more accessible environment can be created for all.

New Forms of Movement

As the automobile is changing so are new movement technologies appearing that will allow us to move through space in new ways. Personal Rapid Transit (PRT), now known as Automated Transit Networks, although it has been around for over 40 years and is still functioning at West Virginia University in Morgantown is now starting to reappear in designs across the world. Heathrow airport opened to the public the most advanced version of PRT. These small car-like driverless vehicles are traveling point-to-point providing safer, more accessible, faster movement directly to your destination. A new elevator system can travel horizontally as well as vertically allowing for greater use of the elevator shaft and potential to create safer access and egress especially in tall buildings. Driverless vehicles are now emerging onto our highways and will impact parking in ways that are currently being explored.

These emerging technologies could change the way we design our cities, towns, and buildings to create safer, more environmentally friendly spaces and places due to their scale and ability to interface with alternative sustainable power sources.

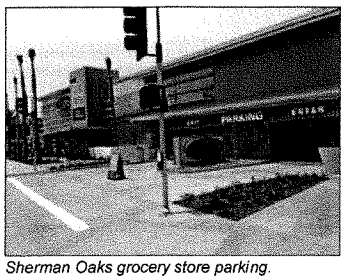
Bicycle Facilities

The integration of the bicycle as an alternative means of transportation is finding a place in parking facility design, as special places designed for the storage and retrieval of bicycle can easily be accommodated within facility design. In many communities across the country, bicycles are becoming a popular mode of transportation. While areas within facilities are accommodating the safe storage of bicycles and many storage systems exist, the facility itself needs to spatially address the different needs of a bicycle driver. The smaller scale and slower speed of the bicycle, along with concentrated pedestrian traffic requires different spatial relationships and design considerations of separation of

man and machine. Separate multi-story and automated bicycle facilities can be found in many places around the United States, starting on the west coast and now Millennium Park in Chicago and Union Station in Washington, D.C.

The Parking Facility as a Community Building Type

The Parking Facility has become a community building type that the majority of us use every day. This building type can be designed to address the role that it plays as the entry and exit place to our cities, towns and buildings. As the vehicle continues to change the building type has the opportunity to integrate even more seamlessly into the urban fabric opening up new design opportunities to create community places and spaces.



Sherman Oaks grocery store parking. (David Vogel: Parking Design Group)

Aging of the Population—Mobility for All

With the aging of the population the driving habits of Americans' are changing. In order to accommodate these changing needs technology can start to play a part such as with vehicles on smart highways and GIS mapping devices. As well as the changing automobile which can drive and park itself opens up new mobility options for many. These new technologies can also improve mobility, driving and parking for everyone.

RELEVANT CODES AND STANDARDS

- International Building Code(/references/ihs_l.php?d=icc%20ibc)—Always check for most recent edition approved by each jurisdiction with every code listed.
- BOCA National Building Code
- Standard Building Code
- Uniform Building Code
- National Building Code of Canada
- Americans with Disabilities Act(http://www.access-board.gov/guidelines-and-standards/buildings-and-sites/about-the-ada-standards) (ADA)
- Architectural and Transportation Barriers Compliance Board (pubs@access-board.gov(mailto:pubs@access-board.gov))
- Local Codes such as the City of Chicago—check your local jurisdiction
- Local Zoning Ordinances—check your local jurisdiction
- National and local Fire and other codes as referenced

MAJOR RESOURCES

WBDG

Products and Systems
Applicable to most items listed within the Products and Systems(productssystems.php) area.

Organizations

- American Planning Association(http://www.planning.org/)
- The Automatic and Mechanical Parking Association(http://www.ampapark.org)—A newly formed association to advance the cause of automatic and mechanical facilities.
- Eno Transportation Foundation(http://www.enotrans.com/)
- The Green Parking Council(http://www.greenparkingcouncil.org/)
- Institute of Transportation Engineers(http://www.ite.org/)
- International Parking Association(http://www.parking.org/)—An advocacy organization for the parking industry.
- National Parking Association(http://www.npapark.org/)—An advocacy organization for the parking industry.
- The National Transportation Research Board(http://www.trb.org/Main/Home.aspx)
- Parking Today(http://www.parkingtoday.com/)—An advocacy organization for the parking industry.
- United States Department of Transportation and State and Local Transportation Agencies
- Urban Land Institute(http://www.uli.org/)

Many related industry organizations such the steel, concrete, construction, engineering, transportation and architecture have their own advocacy organizations and web sites with information on parking facilities issues.

Publications

This is a short list of publications and not at all complete, as this topic has been receiving a great deal of research and interest in the last several years. Please contact all related industry organizations for their most up to date publications for design applications.

- *The Aesthetics of Parking* by T.P. Smith. Chicago, IL: American Planning Association, 1988.
- *The Architecture of Parking* by Simon Henley, New York, NY: Thames & Hudson, Inc, 2007.
- *The Car in 2035: Mobility Planning for the Near Future* by Kati Rubinyi, Ed. New York, NY: Actar, 2013.
- *The Dimensions of Parking* by the Urban Land Institute and National Parking Association. Washington, D.C.: Urban Land Institute, 2000.
- *The High Cost of Free Parking* by Donald Shoup, Chicago, IL: American Planning Association, 2005.
- *Lots of Parking* by John A. Jakle and Keith a. Sculle. Charlottesville, VA: University of Virginia Press, 2004.
- *Metropolitan Parking Structures: A Survey of Architectural Problems and Solutions* by D. Klose. New York: F.A. Praeger, 1965.
- *Open-Deck Steel Framed Parking Structures-A Design Aid* by Emile Troup, P.E. and John Cross, P.E. AISC, 2003.
- *Parking* by Robert Weant and Herbert S. Levinson. Eno Transportation Foundation, 1990.
- *Parking* by G.H. Baker and B. Funaro. New York: Reinhold, 1958.
- *Parking 101: A Parking Primer* by Ronald W. Stehman, Ed. Fredericksburg, VA: International Parking Institute, 2001.
- *Parking: A Handbook of Environmental Design* by J. McCluskey. London: E. & F.N. Spon, 1987.
- *The Parking Garage: Design and Evolution of a Modern Urban Form* by Shannon S. McDonald. Urban Land Institute, 2007.

- *Parking Management Best Practices* by Tod Litman. Chicago, IL: APA Planners Press, 2006.
- *Parking Management—The Next Level*, by Tim Haas, Ed. Fredericksburg, VA, International Parking Institute.
- *Parking Reform Made Easy* by Richard W. Wilson. Washington DC, Island Press, 2013.
- *Parking Selected References Information Packet #327* by the Urban Land Institute. Washington, D.C.: Urban Land Institute, 2000.
- *Parking Spaces: A Design, Implementation, and Use Manual for Architects Planners and Engineers* by Mark Childs. New York: McGraw Hill, 1999.
- *Parking Structures: Planning Design, Construction, Maintenance, and Repair* Editor Anthony P. Chrest. Publisher Springer Science & Business Media, 2001.
- *Parking: The Parking Handbook for Small Communities* by J.D. Edwards. Washington D.C.: Institute for Transportation Engineers; National Main Street Center; National Trust for Historic Preservation, 1994.
- *Precast Prestressed Concrete Parking Structures: Recommended Practice for Design and Construction* by the PCI committee on Parking Structures, and PCI Committee on Parking Marketing & Promotion. Chicago: Precast/Prestressed Concrete Institute, 1997.
- *Reinventing the Automobile: Personal Urban Mobility for the 21st Century* by William Mitchell, Chris Borroni-Bird and Lawrence Burns, Boston, MA: MIT Press, 2010.
- *Rethinking a Lot: The Design and Culture of Parking* by Eran Ben-Joseph, Boston, MA, MIT Press, 2012.
- *Sustainable Parking Garage Design and Management: A Practitioners Handbook*, National Parking Association and International Parking Institute, 2014.

Others

- Building Research Information Knowledgebase(http://www.brikbase.org/research-type/parking-facilities) (BRIK)—an interactive portal offering online access to peer-reviewed research projects and case studies in all facets of building, from predesign, design, and construction through occupancy and reuse.
- Parking Network(http://www.parking-net.com/about-parking-network)

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Table 2 – Private (Off-Street) Parking Supply

ZONE	BLOCK #	ID	NAME/DESCRIPTION	TYPE	GENERAL	H/C	TOTAL
1	1	1	112 Lake St. Back Lot	Private (Mixed Use) Lot	19	0	19
1	1	2	112 Lake St. Front Lot	Private (Mixed Use) Lot	75	2	77
1	1	3	86 Lake St. Lot	Private (Mixed Use) Lot	11	2	13
1	1	4	Heartworks Lot	Private (Customer) Lot	15	1	16
1	1	5	Lake & College Building (60 Lake St.)	Private Garage	56	0	56
1	1	6	Merill Lynch Lot	Private (Mixed Use) Lot	30	2	32
1	1	7	Waterfront Metered Lot	Private (Mixed Use) Lot	6	0	6
1	2	8	Battery & College Garage	Private Garage	173	0	173
1	2	9	Marriott Courtyard Garage	Private Garage	55	3	58
1	2	10	Marriott Courtyard Lot	Private (Customer) Lot	9	0	9
1	2	11	People's United Lot	Private (Customer) Lot	20	6	26
1	2	12	Westgate Tower Garage	Private Garage	70	0	70
1	3	13	Cathedral Sq. Senior Housing Lot	Private (Residential) Lot	29	2	31
1	3	14	St. Paul Cathedral Lower Lot	Private (Mixed Use) Lot	35	0	35
1	3	15	St. Paul Cathedral Upper Lot	Private (Mixed Use) Lot	17	3	20
1	4	16	Costello Courthouse Garage	Private Garage	79	0	79
1	4	17	VT Dept of Labor Lot	Private (Mixed Use) Lot	78	1	79
1	4	18	VT Probabtion Office Lot	Private (Mixed Use) Lot	47	1	48
1	5	19	86 Pearl Street (VT Credit Union)	Private (Mixed Use) Lot	15	0	15
1	5	20	Champlain Apartments	Private (Residential) Lot	17	2	19
1	5	21	Social Security Office	Private (Mixed Use) Lot	19	1	20
1	6	22	Immaculate Conception	Private (Mixed Use) Lot	34	0	34
1	8	23	Burlington BankCard	Private (Mixed Use) Lot	4	0	4
1	8	24	CPA/Law Firm	Private (Mixed Use) Lot	6	0	6
1	8	25	First Baptist Church Back Lot	Private (Mixed Use) Lot	13	0	13
1	8	25	First Baptist Church Front Lot	Private (Mixed Use) Lot	4	0	4
1	8	26	Key Bank ATM	Private (Customer) Lot	2	0	2
1	8	27	Left Bank Back	Private (Mixed Use) Lot	3	0	3
1	8	28	Park Plaza /ICF	Private Garage	107	0	107
1	8	29	Single Pebble	Private (Mixed Use) Lot	4	0	4
1	8	30	Sylvester & Brow	Private (Mixed Use) Lot	6	0	6
1	8	30	VT Federal Credit Union	Private (Customer) Lot	2	0	2
2	9	31	Henry's Diner	Private (Customer) Lot	6	0	6
2	10	32	Daily Planet	Private (Mixed Use) Lot	64	0	64
2	11	33	Mobil Station	Private (Customer) Lot	13	1	14
2	11	34	North Face	Private (Mixed Use) Lot	23	1	24
2	12	35	Allen Agency	Private (Mixed Use) Lot	8	0	8
2	12	36	City Market Front Lot	Private (Customer) Lot	52	5	57
2	12	37	City Market Side Lot	Private (Mixed Use) Lot	10	0	10
2	12	38	Corbin & Palmer Funeral Home	Private (Mixed Use) Lot	21	0	21
2	12	39	Gallery House	Private (Mixed Use) Lot	7	0	7
2	12	40	Howard Center	Private Garage	59	3	62
2	12	41	YMCA	Private (Mixed Use) Lot	7	0	7
2	14	42	UPS Store/Church Lot	Private (Mixed Use) Lot	39	1	40
2	15	43	American Apparel Lot	Private (Mixed Use) Lot	6	0	6
2	15	44	Clothing Line Lot	Private (Mixed Use) Lot	4	0	4
2	15	45	Penny Clue Café	Private (Customer) Lot	2	0	2
2	15	46	Shell Station Lot	Private (Mixed Use) Lot	10	0	10
2	16	47	Farmhouse	Private (Customer) Lot	7	0	7
2	16	48	NBT Bank	Private (Mixed Use) Lot	20	0	20
2	17	49	Masonic Temple Building	Private (Mixed Use) Lot	6	0	6
2	17	50	State Office Building	Private (Mixed Use) Lot	12	0	12
2	17	51	State Office Building	Private Garage	388	0	388
2	17	52	Urban Outfitters	Private (Customer) Lot	7	0	7
2	18	53	First Unitarian Church	Private (Mixed Use) Lot	50	0	50
2	19	54	Act 1 Lot	Private (Mixed Use) Lot	9	1	10
2	19	55	Metro Hair	Private (Mixed Use) Lot	40	0	40
2	20	56	Ben & Jerry's Back Lot	Private (Mixed Use) Lot	12	0	12
2	20	57	Burlington Labs	Private (Mixed Use) Lot	20	0	20
2	20	58	Rite Aid	Private (Mixed Use) Lot	38	0	38
2	20	59	Spectrum Health Services	Private (Mixed Use) Lot	3	0	3
2	21	60	215 Pearl Street	Private (Mixed Use) Lot	10	0	10
2	21	61	First Congregational Church (back)	Private (Customer) Lot	14	0	14
2	21	62	First Congregational Church (front)	Private (Mixed Use) Lot	15	0	15
2	21	63	Ronald McDonald House	Private (Customer) Lot	19	0	19
2	22	64	6 Orchard Terrace Back Lot	Private (Mixed Use) Lot	10	0	10
2	22	65	233 Pearl Street (Goldberg, Atty)	Private (Mixed Use) Lot	3	0	3
3	23	66	Cornerstone Bldg Garage (top)	Private Garage	42	2	44
3	23	67	Ice House	Private (Mixed Use) Lot	30	1	31
3	23	68	Main Street Landing	Private (Mixed Use) Lot	118	0	118
3	24	69	April Cornell Parking Lot #1	Private (Customer) Lot	9	0	9
3	24	70	April Cornell Parking Lot #2	Private (Mixed Use) Lot	16	0	16
3	24	71	Burlington Bay Lot #1	Private (Customer) Lot	7	0	7
3	24	72	Burlington Bay Lot #2	Private (Mixed Use) Lot	17	0	17
3	25	73	Chamber of Commerce	Private (Mixed Use) Lot	16	1	17
3	25	74	Gateway Center	Private Garage	359	6	365
3	25	75	Pomerleau Real Estate	Private (Mixed Use) Lot	23	0	23
3	26	76	Barber Shop	Private (Mixed Use) Lot	13	0	13
3	26	77	Rehab Sports Center	Private (Mixed Use) Lot	43	0	43
3	26	78	Rock Point	Private (Mixed Use) Lot	16	0	16
3	26	79	Salvation Army	Private (Mixed Use) Lot	13	0	13
3	26	80	South Sq. Apartments	Private (Residential) Lot	21	0	21
3	27	81	118 Pine Street	Private (Mixed Use) Lot	3	0	3
3	27	82	120 Pine Street	Private (Mixed Use) Lot	14	0	14
3	27	83	135 College Street	Private (Mixed Use) Lot	19	0	19
3	27	84	Burlington Place	Private (Mixed Use) Lot	37	0	37
3	27	85	Magnolia/ Black Cat	Private (Mixed Use) Lot	14	0	14
3	28	86	Champlain Housing Trust	Private Garage	20	0	20
3	28	86	Champlain Housing Trust (back)	Private (Residential) Lot	6	2	8
3	28	87	Hilton Garden Inn	Private Garage	87	0	87
3	28	88	TD Bank Lot	Private (Customer) Lot	7	0	7
3	29	89	150 S. Champlain Street	Private (Mixed Use) Lot	49	0	49
3	29	90	153 Pine Street	Private (Residential) Lot	13	0	13
3	29	91	Northern Lights	Private (Mixed Use) Lot	21	0	21
3	30	92	26 King Street	Private (Residential) Lot	7	0	7
3	30	93	Aneon & The Little Pear	Private (Mixed Use) Lot	17	0	17
3	30	93	August First Bakery	Private (Customer) Lot	2	0	2
3	30	94	BHA Parking	Private (Residential) Lot	16	1	17
3	30	95	The Holloway Block	Private (Mixed Use) Lot	78	0	78
3	31	96	Dorr & Whitier Building	Private (Mixed Use) Lot	44	0	44
3	31	97	Gedeon King House	Private (Customer) Lot	14	0	14
3	31	98	Permit Lot@ Maple & S. Champlain	Private (Mixed Use) Lot	38	0	38
3	31	99	Waterfront Plaza Garage	Private Garage	100	0	100
3	32	100	185 Pine Street	Private (Residential) Lot	9	0	9
3	32	101	BTV Housing Authority	Private (Residential) Lot	14	0	14
3	33	102	120-122 Maple Street	Private (Residential) Lot	22	0	22
3	33	103	Strates Building	Private (Mixed Use) Lot	27	2	29
4	34	104	133 King Street	Private (Mixed Use) Lot	9	0	9
4	34	105	194 St. Paul Street	Private (Mixed Use) Lot	17	0	17
4	34	106	Champlain College	Private (Customer) Lot	11	0	11
4	35	107	174 Maple Street	Private (Residential) Lot	7	0	7
4	35	108	Burlington Telecom	Private (Mixed Use) Lot	103	0	103
4	36	109	County Superior Court	Private (Mixed Use) Lot	31	0	31
4	36	110	Courthouse Plaza Garage	Private Garage	210	0	210
4	37	111	134 King Street	Private (Mixed Use) Lot	16	0	16
4	37	112	Flynn Theater	Private (Mixed Use) Lot	10	0	10
4	37	113	Two Properties	Private (Customer) Lot	2	0	2
4	37	114	Vermont House	Private Garage	41	0	41
4	39	115	Free Press Media	Private (Employee) Lot	10	0	10
4	39	116	Nectar's	Private (Mixed Use) Lot	5	0	5
4	40	117	Burlington DPW	Private (Mixed Use) Lot	9	0	9
4	40	118	College St. Congregational Church	Private (Mixed Use) Lot	21	0	21
4	40	119	Fletcher Free Library	Private (Employee) Lot	7	0	7
TOTAL					4,004	53	4,057

Submitted by

S. Overby