FHWA-NJ-2007-002

Transit Friendly Parking Structure Guidelines:

Planning, Design, and Stewardship

FINAL REPORT
June 2007

Submitted by

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In cooperation with NJ Transit

DISCLAIMER STATEMENT

1. Report No. **FHWA-NJ-2007-002**	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle **Transit Friendly Parking Structure Guidelines: Planning, Design, and Stewardship**		5. Report Date: **June 2007**
		6. Performing Organization Code
7. Author(s) **Darius Sollohub**		8. Performing Organization Report No.
9. Performing Organization Name and Address **Infrastructure Planning Program** **New Jersey School of Architecture at NJIT** **Newark NJ 07102**		10. Work Unit No.
		11. Contract or Grant No. **FHWA-NJ-2007-002**
12. Sponsoring Agency Name and Address		13. Type of Report and Period Covered
15. Supplementary Notes		

16. Abstract

Parking is a critical concern in our auto-dominated society and has a significant impact on our landscape. Transit facilities, which often include parking, are challenged by many parking related issues. The research problem that Transit Friendly Parking Structure Guidelines seeks to solve is to identify best practices for developing structured parking in downtowns that focus on transit.

The multi-year grant's methodology involved a multidisciplinary effort that utilized faculty and staff of NJIT's Departments of Architecture, Infrastructure Planning, Civil and Transportation Engineering, assisted by Rutgers's Voorhees Transportation Policy Institute and the Urban Land Institute. Grant activities included two graduate design studios, one at Rutgers and one at NJIT, focusing student teams on different aspects of the problem. In addition, several symposia were held at which experts in the field commented on the process. Two related studies, the Urban Land Institute Advisory Panel and Parking Matters furthered the investigation of the subject. Work began in September of 2004 and concludes with the final acceptance of this report in June of 2007.

Transit Friendly Parking Structure Guidelines has three objectives: The first is to present current practice through a comprehensive, multi-disciplinary literature review; through consultation with experts at both the agency and professional levels; and by examining and documenting parking facilities in the field. The second is to offer conceptual designs of facilities at four locations in New Jersey and analyze their feasibility. From this experience, design guidelines and management standards, the third objective, were developed that utilize state-of-the-art practice, specifically tailored to conditions around New Jersey's transit facilities. These were imparted to NJ Transit staff and their consultants through symposia, this report, and a series of presentations. It should be noted that these parameters are finely tuned for the particular application in transit focused downtowns, even though some best practices are gleaned from places that do not fit this description. These guidelines and standards are organized according to three inter-related subject areas: planning, design and stewardship.

17. Key Words		18. Distribution Statement	
19. Security Classif (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No of Pages 241	22. Price

ACKNOWLEGEMENTS

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EXECUTIVE SUMMARY

Across America, any public discussion of downtown parking typically evokes controversy. This document focuses on the point in a community's evolution where that controversy becomes acute: when a community can no longer manage its parking needs with surface parking but must transition to structured parking, that point when a town begins to take on attributes of a city. This document seeks first to understand that acute controversy and then to identify methods to overcome it, covering all aspects of the process from planning, through design and the stewardship of parking into the future.

The literature associated with building structured parking in downtowns includes many excellent design and operations manuals written and published by industry trade organizations, professional organizations, research centers and private sector practitioners. These focus primarily on the technical aspects of structured parking's development, offering limited, if any, recommendations on community process. And while community design has been practiced now for decades, few of the many writings associated with it specifically address the development of structured parking. While research for this document has been underway, a spate of new writing focuses in greater depth on the history of urban parking, on parking's role in development strategies, and on pointed criticism directed at demand standards currently used.

Planning

Planning is a process that defines what a community needs, and establishes in general terms, what is possible. It begins with reconciling those needs with a community's environment. Planning also establishes the balance between quality and the ability to pay for it.

The broader community must be involved in order to give a structured parking project the greatest chance of success. This cannot be underestimated as the flash points of developing structured parking are many: Parking is an enormous consumer of land, a scarce commodity in expanding downtowns and to build one requires substantial financial commitment. Structured parking is bulky and has negative connotations. This study uses two New Jersey examples as precedents, Princeton and Westfield, to compare one's town's success to the other's failure.

Key to an effective process is openness to not only a project's opportunities but also its liabilities. The process should be proactive, not reactive. While the additional traffic that a project will bring must be clearly understood, the potential for greater vitality must also be planned for. The land use patterns associated with downtowns, especially older ones, are typically complex in nature. While one seldom finds local zoning in these mixed-use environments that allows parking to be built as-of-right, there are three primary advantages to building structured parking there that can become proactive arguments for redevelopment planning or in pursuing a variance. First, mixed-use environments allow parking to be shared, which can minimize its size. Second, its massiveness can be mitigated or shielded when combined with other programs. Third, where a parking structure has multiple users, revenue generated by them, combined with adjacent development, can offset the ever increasing costs of development and help make a parking structure self-sustaining.

Parking demand in downtown environments is lower than typical suburban conditions, for which most current parking standards are based. Three reasons exist for this. First, the presence of transit in these environments reduces typical parking demand ratios based on the density of the downtown and the degree of transit service available. Second, downtown travelers also exhibit multi-purpose travel behavior where they park once and then walk to various destinations during their stay. This affects the parking demand of secondary purpose destinations such as restaurants and retail stores that serve persons that are in downtown for another primary purpose, such as work , a visit to a professional office or a residence. And third, shared parking is an emerging best practice that allows a significant reduction of parking supply through a complementary mix of uses. When different uses have parking peaks at different times of the day or week, the same spaces can be used to satisfy more than one use.

Shared parking spaces fall into three categories: first, those used by employees and residents, characterized by low turnover, longer stays, and familiarity with the system; second, spaces used by retail patrons and visitors, characterized by high turnover, short stays, and possibly unfamiliar users; and third, spaces reserved for use by individuals or particular use groups. Commuter parking projects fall into the first and third categories. Housing represents an ideal complementary program for commuter parking with similar characteristics (low turnover, longer stays and familiar users) and exactly opposite peak demands times. The challenge is to capture as many of these users as possible in one parking facility.

The quality of the parking experience must also be carefully calibrated. Similar to other transportation systems, this is measured, and planned for, as a "level of service." Regarding a parking structure for its qualities is an uphill battle, as parking structures by default invoke considerable stigma. They are generally regarded as secondary spaces, with all the charm of basements and back alleys. They can be maze-like and potentially anxiety producing; it is not surprising that Hollywood films often set unseemly activity within them. To counter this stigma, higher quality in parking structures typically translate to generous accommodation – higher ceilings, gentler slopes and shorter walking distances – which often lead to increased cost. Other level of service factors – being tailored to a specific user and location – can improve quality while not necessarily adding cost.

A parking structure that is adjacent to transit is, by definition, an intermodal facility; essentially a park and ride. It can, however, be so much more than what we typically associate with park and rides: a parking lot next to a highway interchange. When parking structures are close to a train station, but not too close, the path from them to the station and back again allows for commuter amenities. Commuters can split their errands for efficiency, dropping off (dry cleaning, orders, papers) in the morning and picking up (prepared meals, cleaning, mail) on the way home. As a mixed-use facility, the parking structure can also serve these same amenities and others, including retail, institutional and entertainment, and housing. The more vitality there is to a downtown, the less need there is to drive - for everyone; those living downtown would use their cars only when they need to depart, while other patrons can use the garage to park once and negotiate the downtown on foot.

To design parking structures well, one must give as much attention to access for the vehicle as to access for the pedestrian. Where the portals are located, how they are controlled, and what streets lead up to them, each have enormous impact on the quality of the individual experience, and on the larger downtown environment. Sensing and communication systems technologies developed for parking structures increase efficiency, although they primarily benefit large systems and facilities, and have limited applicability to downtown structures. Devices exist to measure vacancies in an entire garage and even at individual stalls, information which can then be transmitted to users. Various communications systems are available that allow users to reserve or pay for parking through the internet, and increasingly, by using handhelds.

Parking structures must typically charge a fee, given the need to control volume and because of the high cost of their development. Charging for parking also encourages transit use. How this fee is paid affects both the operation of the facility and the experience of the user. In a downtown environment, a municipality simply cannot cover the capital costs (design and construction) and operating costs (finance charges and stewardship) of structured parking without a reliable revenue stream. The cost of building structured parking is currently rising at a steady rate and the cost to amortize it would require monthly payments that are twice what commuters typically are willing pay. Without a major change to expectations, it is critical that operators of commuter parking seek other users that can supplement revenue. The financing tools available to municipalities are revenue bond financing, tax financing, and qualitative/parking systems (otherwise known as enhancements/ supplemental financing).

Design

Once needs and possibilities are determined in the planning process, a project must be designed to satisfy those needs within the parameters chosen with regard to function, cost, the impact on surroundings and the quality of experiencing it. Design encompasses engineering – the determination of what the project is physically and how it is built, urbanism – how a project integrates and harmonizes with its immediate and broader environment, and its architecture – how all a project's constituent parts are coordinated to achieve the highest possible quality of experience.

Parking structures come in three basic types: open, enclosed and underground. Enclosed structures (above and below ground) typically are more expensive to build and operate because of added complexity and because they require mechanical ventilation and fire suppression systems. Four structural systems are typically used: cast in place concrete, post tensioned cast in place concrete, pre cast concrete, and structural steel. Parking structures are in effect extensions of paved roadways and are often subject to the same challenges. Artificial lighting in parking structures makes fixed objects, vehicles, and pedestrians visible and has a major impact on safety and security. Quality and quantity of lighting reduce crime and contribute to the user's perception of safety and security.

Vehicular access to a downtown parking structure is largely determined by how one pays to use it, whether it is automated or not, and if so, how sophisticated are its automation systems. Access is also affected by the relationship between a primary user and additional users. Where primary users are transit commuters, arriving and departing at peak periods, their use will be impacted by other vehicles, both parked and moving. An important consideration for locating a structure and its access points is the local street network, how that network performs at peak periods and some understanding of how a downtowns traffic patterns will evolve. Pedestrian access to a parking structure should provide wayfinding cues that help users locate their cars and integrate with a downtown's circulation patterns through the location of elevators and stairways.

Construction costs for structured parking vary due to construction type, foundations required, parking design efficiency, architectural treatments, amenities, labor costs and market factors. These variables result in above ground structured parking costs of from $15,000 to $20,000 per parking space as of July 2007. (for planning purposes cost is typically measured per parking space). Geologic site conditions and the number of levels of parking below grade affect underground parking costs, which can be expected to be 50% more than above grade structures for the first level below grade, and twice the cost for each level below that.

Urbanism governs the overall design of downtown environments. How well a parking structure integrates with a downtown environment can be critical to its success. Urbanism today is a major component in Smart Growth planning strategies that seek to concentrate residential and commercial uses in downtown areas in order to combat suburban sprawl. These downtowns are intended to be compact, transit-oriented, walkable, bicycle-friendly, and include mixed-use development with a range of housing choices. Smart Growth planning is meant to be comprehensive and equitable, focusing on long-range, regional considerations of sustainability instead of short-term gain. Yet many correlate the density associated with downtown concentration with the negative side of becoming urban - crowding, crime and bad schools – without recognizing the positive aspects – amenity and choice. Because Smart Growth concepts are not universally agreed upon, implementation is measured by degrees – how many elements of smart growth a downtown exhibits. Sometimes, smart growth elements contradict one another, as they do with structured parking, where critics might argue that the provision of parking encourages driving over transit. These critics forget that Smart Growth maximizes choices and parking can be simply a choice, especially when priced accordingly. Except in US environments with a well developed transit culture such as New York City, structured parking is essential to densification required to foster a vital downtown.

The paradigm for Smart Growth downtowns is Transit Oriented Development or the Transit Village. This type of development typically surrounds a train station with relatively high-density, mixed-use development followed by progressively lower densities spreading outward from the center. Transit Villages are typically defined as a minimum ¼ to a maximum ½ mile radius from a transit stop or a five or ten minute walk respectively. Structured parking can establish measurements similar to those of Transit Villages, generating its own radii based on the distance from parking to a retail destination or housing.

Transit stations combined with structured parking can create powerful, bi-nucleic generators of high quality urban density. Even without the presence of transit, downtown parking can create significant adjacent density; some of the best examples cited in this report do so.

The attributes of Transit Oriented Development (TOD) are the 4 D's: density, diversity, design and destination. Density refers to a consolidation of residential with commercial, office, institutional, or other activities. Transit Village commercial enterprises are usually small market, individually owned, although recently some national chains have located there. Ideally, they satisfy needs of commuters arriving at or leaving the station. Institutions such as universities and office development can also be major anchors of TOD as evidenced by New Brunswick. TOD are often measured according to dwelling units per acre (DUA). Transit villages can range from 12 DUA up to 50 DUA. Beyond 50 DUA elevators become necessary for housing and beyond 20 DUA, structured parking is typically required for residential development. Recent research reports that market-rate downtown housing is populated by professionals without children and retirees, dispelling the dread, especially acute in New Jersey, that density necessarily leads to overburdening public schools.

Smart Growth diversity describes heterogeneity of land uses in downtowns, including retail, office and housing. These downtowns are populated by a variety of income, age and racial groups, and their mobility options are maximized using a diverse strategy that counters the common practice of organizing land use in sectors (which typically requires automobile trips, not walking, between home, work, commerce, school, etc). Diversity as it relates to structured parking argues that it cannot be financially self liquidating unless it can share parking spaces with other uses.

While density and diversity can be measured empirically, design is primarily aesthetic and judged qualitatively. The design of a street or streetscape can make a walking trip seem far shorter than it is. Streetscapes are designed as metaphorical urban rooms where walls, ceilings, furniture and other elements complement one another. Because aesthetics can be so subjective, this is the area of strongest disagreement amongst planners, urban designers, and architects who align themselves on one extreme with New Urbanism (a recent urban design movement popular in New Jersey that relies on traditional urban design formulas), and orthodox modernists designers (primarily centered in the design schools and press). These groups otherwise might agree on measures of density and diversity but often disagree on aesthetics.

Destination refers to travel options. TOD must first and foremost be walkable if not bikeable. Necessarily, it need not be served by rail transit if good bus connectivity prevails. In this kind of environment, structured parking serves as a destination where visitors park once and walk to potentially multiple venues. Downtown Princeton NJ is an excellent example of a highly functional TOD that is not immediately adjacent to rail transit. Several other TOD examples from around the country, where structured parking helps establish them as destinations, include Mockingbird Station in Dallas TX, Lindbergh City Center in Atlanta GA, and Downtown Silver Spring near Washington DC.

Architecture plays a critical role in the final "fit" of structured parking into downtown environments. Prior to WWII, garages were patterned on urban stables. In the postwar years, parking garages evolved into classic modern forms that reflected function and movement. Paul Rudolph's Temple Street Garage, built in the 1962 in New Haven CT is an excellent example, designed as a monument meant to be seen. Today, attitudes have come full circle in downtown New Jersey, where parking structures are designed to be demure: "used but not seen." To achieve this, designers apply a thin veneer as camouflage to make garages look like housing or office buildings. Recently, some projects have sought to mitigate a parking structure's presence not through disguise but by integrating with other uses.

While today's parking structure might be humbler buildings than their predecessors, their interiors still require architectural attention. They should be uncomplicated, experiencing them should be as safe and comfortable as possible: floors should be level, without excessive or erratic slope for drainage, walls should allow as much light as possible to penetrate, and columns, lights, and windows should be evenly spaced and logically arranged. The open roofs of parking structures offer hidden opportunities. Johnson & Johnson has placed photovoltaic panels there; others have planted them as green roofs. And according to former Princeton Mayor Marvin Reed, painting the interiors is, dollar for dollar, money well spent.

Parking structure portals are best kept to a minimum in downtown areas and should have other attributes clustered around them like the parking management office, retail and any other activity available - the more activity the better. Handicapped parking should be near a structure's portals.

A parking structure's tower, which typically contain a stair and one or more elevators, can play important aesthetic and functional roles. Like those on town halls, train stations, firehouses and places of worship, towers can become civic landmarks. Building codes regulate their function and dimensions, most notably that they extend beyond the parking structure's highest level. Design manuals recommend employing as much glass as possible in both elevators and stairs for safety reasons. This provide a sense of openness that makes patrons feel more secure. To enhance this sense of security, stairs, elevators, and the spaces that adjoin them, should be generously dimensioned, well lit and cleaned regularly.

Facades (referred to as elevations by architects) are the parts of a parking structure seen from the outside. In many locations, especially where there is no surrounding context, they are left as they come from the prefabricator: unadorned. In established downtown environments, citizens often demand that parking structures be clad, or "dressed" with materials consistent with the surrounding environment. They demand this for several reasons. The first is bulk; they are larger than almost anything around them; second, the rawness of the concrete, and third, they are relentlessness horizontal. Dressing up a prefabricated parking structure can be as simple as painting or cladding its long horizontal sides with tile, brick or other materials. More complex measures involve attaching a complete façade that can cover a parking structure's exterior vertical surface. These facades, or "screens," can take almost any form, so long as they allow the percentage of openings required by code. A recent innovation uses nylon scrim. Facades often mimic the proportion and orientation of nearby buildings. These are often domestically scaled vertical windows that correspond to a downtown context. To further the illusion of downtown scale, these windows are often arranged as individual building elevations that simulate an entire block front of buildings. While this strategy won't likely win any architectural awards, many municipalities find that this is the only way to convince their residents to allow structured parking. The Village of Ridgewood is on the road to success on its second attempt at developing structured parking with a proposal that mimics the village like atmosphere of its neighbors.

Several examples of best practices can be observed in Princeton, NJ. The New South Parking Garage on the Princeton University Campus uses a sophisticated form of architectural screening. Designed by Enrique Norton of Ten Arquitectos of Mexico City and Walker Parking Consultants of Indianapolis, the structure is clad in a shimmering skin of stainless steel mesh. From a distance, the silhouette of the garage's horizontal openings is clearly visible behind the mesh, which reflects the sun and gives the silver box a volumetric quality. It is at once a standard parking structure and something else entirely. Like a veil, the mesh makes that which is behind it more alluring. The project also received an American Institute of Architects Award, the Gold Medal from the New Jersey Chapter in 2002.

The Spring Street garage is operated by Princeton Borough and not the University, offers an excellent example of the strategy of integration. Rather than cladding the structure with stainless steel mesh, it is partially surrounded by housing and benefits from integration in a larger composition that includes a pedestrian network, a public plaza, the municipal library, stores and restaurants. The two exposed sides of the structure are clad with very simple and inexpensive materials designed to look like the surrounding context, with domestic scale openings punctuating the larger surface. The plaza area, entirely shielded from the garage by housing, is the highest quality space of the ensemble and the culmination of Chambers Walk, a pedestrian sequence lined with shops that courses through downtown Princeton.

Stewardship

If well planned and designed, a downtown parking structure cannot ultimately succeed without effective stewardship. Parking facilities experience unusually harsh exposure conditions compared to most buildings. An effective maintenance program inhibits deterioration and prevents equipment failure. The three broad categories of parking facility maintenance are *structural*, *operational*, and *aesthetic*. Actions taken to perform maintenance for each category include routine and preventative maintenance and replacement.

Stewardship involves revenue production, and cost effective payment systems can enhance a parking structures ability to pay for itself and allow complementary uses. Facilities serving commuters and residential parkers are typically gated, utilizing some form of monthly payment system (magnetic, bar code, etc), to control access. For daily users - retail patrons or one time travelers - Pay on Foot is the current standard; only by pre-paying and surrendering a ticket upon exit can one exit the facility.

Keeping a garage secure is critical to its success. Parking facilities represent large volumes of space with limited activity, are open to the public, and contain many hiding places. Statistically, they are at higher risk of crime than many other uses. Security minimizes the actual or perceived risk in parking structures. Perception is critical; the more secure a facility appears, the more parkers will accept and use it. Crime Prevention through Environmental Design (CPTED) emphasizes how creative environments can reduce crime and enhance spatial quality. A security audit is the first step of the CPTED process. Security in its passive form involves visibility and includes effective lighting, glass walled elevators and stairs. Active security is about response by employees such as security patrols and video monitoring.

Valet services and carsharing are several emerging practices in line with Smart Growth goals that enhance the transit parking experience. Valet services are often employed during the construction of structured parking, especially when the garage replaces a surface lot and its regular users are displaced. Once construction is completed, valet services can remain in place as a premium service and to maximize efficiency, particularly at shared parking overlap times, such as when arriving early may find no parking available. In this case, commuters can simply leave their cars curbside and a valet moves it later when space becomes available in the structure. Later, the commuter picks up their keys with a locator card and retrieves their own vehicle. Summit's commuter oriented valet service has been in operation since 2001, and because demand has outstripped supply, is presently negotiating to acquire more space.

Car sharing is an emerging practice in urban areas across the US where cars are made available in a convenient location on an hourly basis without involving a typical rental arrangement. It has significant environmental benefits: fewer parking spaces are required to meet the same driving needs, lower fuel consumption results in less pollution as older model cars are replaced with newer models with better pollution controls, congestion is reduced as one shared car replaces more than six privately owned ones , and studies indicate mass transit use rises among car share users. Finally, car sharing promotes a deeper sense of community as members within a small geographic area share a common resource and because they no longer spend a significant portion of household income on car ownership, they often buy locally. In New Jersey, service is offered in Hoboken, Jersey City, Princeton and other locations.

Design Testing

A graduate design studio, comprised of eleven students in the Masters of Architecture program at the New Jersey School of Architecture, sought to apply the principles developed in this document to determine if the guidelines and strategies previously identified could be successfully employed in local, real world situations to mitigate the common inhibitors, or overcome the significant challenges, that stand in the way of a successful structured parking solution. Those common inhibitors are typically associated with the size and presence of parking structures, and with their integration into downtown environments.

The New Jersey towns that hosted the design testing were Red Bank, Ridgewood, Metuchen, and East Orange. A brief introduction to the towns and their unique characteristics and challenges, the results of a planning studio held at Rutgers, can be found in Appendix B. The specific elements of each proposed site solution and the results of the design studio, can be found in Appendix C.

The design challenges addressed by the students were many. From the perspective of size: how does a community deal with a built structure that is significantly taller or broader than anything in its vicinity, whose mass simply dominates its nearby surroundings? How can the introduction of a building whose mass implies urbanization be done in such a way that the host community that does not want to become 'urban', can be satisfied?

From the perspective of streetscape: what are potential proper treatments for a building whose very mass threatens to disrupt the fabric of the existing street scene in the community, whose purpose or function runs counter to the ambience or street life the community desires? How can that building be made to fit it? Is it appropriate to attempt to disguise the structure? Is it even possible to disguise it? With what might it be disguised, an imitation of its context? Can it be hidden from the street, wrapped with other program?

This study concludes emphatically that the inclusion of additional users in a structured parking development project, even in a project specifically designed to resolve transit parking supply issues, is the wisest approach. These proposals all incorporate, to some degree, a mix of the most important primary uses: residential, work, and retail. But they also introduce additional, creative uses that appear to have a natural synergy with the transit experience. These include day care and fitness centers, but also can include more general uses such as municipal services (library) and other civic uses (performing arts, veterans' center).

The inclusion of housing, specifically, provides the pool of people required for sufficient concentration, particularly in the evenings, when the concentrations created during business hours by the presence of retail have subsided. It is this complementary mix that assures a level of activity that is balanced throughout the day and that promotes vibrancy and urban health.

Additionally, the inclusion of housing, specifically, is the most synergistic fit for the developer implementing transit-oriented principles. While parking is naturally available for new residents, the new residents also form a natural pool of transit riders.

Finally, the integration of elements other than parking; such as housing, dining, and retail make financial sense as well. The inclusion of additional program provides revenue streams that enable the cost of parking to be subsidized so that the users or the community don't suffer the "sticker shock" associated with the real cost of parking.

LITERATURE SEARCH

An analysis of the literature related to parking in medium scale downtown locations yields several design and operations manuals and relatively few critical research documents that are academic in nature. Many of these are comprehensive, covering all aspects of planning, design and stewardship in varying degrees of detail, while others are specific to a subset of analysis or even a single topic. Others texts, specifically those related to parking's connection to the larger urban context, deal with much broader issues, only dealing with downtown parking where it overlaps with those broader issues. These fall largely in the area of community planning, urban design, architecture and transportation engineering.

The design and operations manuals are published by industry trade organizations such as the National Parking Association (NPA) often in conjunction with research organizations such as the Urban Land Institute (ULI). Perhaps the most comprehensive manual (Chrest et al., 2001) is produced largely by principals at one of the largest private sector design consultants, Walker Parking.

A list of sources general to the three-pronged organization of this report – planning, design, and stewardship - follows:

Planning

Engaging the community is critical to developing successful downtown parking strategies. The recognized process to achieve this is often referred to as "visioning" or "placemaking". These are an outcome of the broader community activism begun by Jane Jacobs (1961) in response to the "top down" draconian planning characterized by federal urban renewal programs of the 1950-60's. The response, known as "bottom up" or "grass roots" planning, galvanized communities in a democratic process that sought general consensus over a community's future. Visioning is achieved through an iterative process known as charrettes. These strategies are codified by a variety of organizations such as the APA (2006) National Civic League (NCL, 2000), and Walzer (1996). Organizations that provide guidance and direction in these matters are the National Charrette Institute (NCI) (www.charretteinstitute.org) and the Sustainable Communities Network (SCN) (www.sustainable.org), which maintains a list of related sites at www.sustainable.org/creating/vision.

The land use ordinances associated with downtown parking typically fall within commercially zoned areas under the "C" heading such as General Retail Commercial Center Districts. These are often derived from the boilerplate ordinances provided by the American Bar Association (ABA) or commissioned by municipal ordinance writers such as the Municipal Code Corporation (MCC), who have recently produced ordinances for the New Jersey communities of Hamilton, Randolph and South Brunswick. These codes often dictate off-street parking standards for residential, mixed-use districts and commercial districts. These typically originate from national standards which then local entities adopt. Growing criticism of widely used standards as unfriendly to the mixed-use environments of downtowns has come from a variety of sources from the Congress of New Urbanism (CNU), such as Leccesse, et al (2001), the Smart Growth Council, the ULI and recently in a strident call for reform from Shoup (2005). In a larger context, Pendall et al (2006) has reviewed land use regulations of the US's 50 largest metropolitan areas, identifying key areas of reform related to parking. The Local Government Commission (LGC) (2003) has issued a resource guide on smart growth zoning codes that cite reform strategies for parking. It is likely that many communities with downtowns will adopt some type of form based codes as described and codified by Barnett (2004), Sitkowski (2006), Crawford (2004). In March, 2007 NPA issued in an update of "Recommended Zoning Ordinance Provisions for Off-Street Parking", which contains significant discussion of how to accommodate Smart Growth and New Urbanism approaches to Parking Ordinances.

Advocates of smart growth planning in downtowns generally recommend proximity to some form of transit, ideally heavy or light rail or buses, which then make them transit oriented developments (TOD). Calthorpe (1993) and Bernick and Cervero (1996) describe TOD as pedestrian-friendly, mixed-use, within walking distance of transit with an adjacent commercial area. This TOD literature typically describes parking in terms of recommended ratios and locations but with no capacity maximums or specifics on parking structures. In the absence of specific literature on the topic, guidance can be taken from case study descriptions in Bernick and Cervero(1996), Owens-Viani (2000) and Shutkin's (2000) description of planning, designing and building structured parking at the Fruitvale, CA Bart Station.

Given the growing tendency of parking facilities and structures to accommodate a mixture of uses, the sharing of parking has become topical. Shoup (2006) cites it as a major strategy for inhibiting the oversupply of parking. ULI has published several documents on the topic, the most recent by Smith (2005).

The relationship of the various levels of service to different use groups and other characteristics is described in Chrest et al (2001), while access, circulation and capacity issues are comprehensively documented in Chrest (2001), NPA (2000, 2002) and APA (2006). The financing of downtown parking, which this document touches only tangentially, references Morgan et al (2006), Chrest et al (2001) and Heeseler (1991).

Design

Chrest et al (2001) describe the various engineered components of parking structures from the choice of materials, foundation concerns including seismic, mechanical, electrical and plumbing systems integration, lighting, construction management and life cycle cost analysis. NPA/ULI (2000) NPA (2002) and APA (2006) each describe the selection of type, or which configuration of ramps most appropriate to a given condition. NPA (2002) specifically focuses on the metrics and geometry associated with parking structure vehicular circulation. NPA (2003) provides a comprehensive appraisal of the re-emergence of Automated & Mechanical Parking facilities. Emerging parking systems technologies are surveyed by Smith and Roth (2003). Specific guidance systems for transit are documented by Shaheen et al (2004).

Jakle and Sculle (2004) comprehensively trace the history of parking in the 20th century American city from the first parking lots and meters to garages. The forthcoming book by MacDonald (understood for the purposes of this study from conference proceedings and publications) will extensively document the history of structured parking as a type. The renewed appreciation for the American downtown by the general public is both documented and propelled by Duany, Plater-Zyberk, and Speck (2000) and Calthorpe (1993) and Calthorpe and Fulton (2001) who argue for a "New Urbanism." In most regards, Smart Growth planning and Urban Design Strategies as described by Barnett (1996), Porter, Dunphy & Salvesen (2002) closely parallel those of New Urbanism with regard to promoting pedestrian environments, use of transit, streetscapes and mixed uses. Some disagreement exists, voiced by Krieger (1998) and Marshall (2001) regarding the architecture of the final product and the degree to which all standards are met. Prior to the creation of terms such as new urbanism and smart growth, Lynch (1981) identified many of their attributes in describing the "good city."

In concert with modern planning, 20th century modern architecture valorized the automobile through the early writings of Le Corbusier (1923, 1925), Wright (1932) and later Banham (1971). The form follows function mantra of high modern architecture in the 20th century made the parking structure one of its icons, with many well known practitioners designing the type. These are catalogued by Klose (1965) and Andreani (1995). Reacting to modernism's orthodoxy, post modern architecture (Klotz, 1988) made the ornamentation and even masking of the garages acceptable within the design community. In recent years modernism's restraint has returned and post modern design strategies have evolved to the deployment of semi-transparent building enclosures that mask yet reveal the parking structures forms (Riley, 1995). Finally, the integration of architecture with urbanism that can follow a neo-traditionalist strategy or a neo modern one argue for the full integration of structured parking with other architectural programs.

Stewardship

The sundry responsibilities of operating and maintaining parking facilities, both at grade and structured, are described in omnibus manner in Chrest et al (2001) and NPA/ULI (2000).

These include payment procedures, leases and contracts, contract and concession agreements, maintenance, insurance and staffing. An NPA (2004) manual for structured parking maintenance discusses repairs, appraisal of conditions, rehabilitation and restoration strategies and maintenance budgets. While Chrest et al (2001) and NPA/ULI (2000) cover issues of security, NPA (2000) publishes a document solely devoted to the topic.

PLANNING

Planning is a process that defines what a community needs, and establishes in general terms, what is possible. The planning components described in this section represent all the steps that are necessary to take *before* a parking structure begins construction. Subjects that are typically the domain of the architect, engineer or steward are discussed here and not in subsequent sections because these must be coordinated in the planning phase. It is in the planning phase that the relationship between capacities, qualities and payment is established. These begin with **community** planning; the open and transparent outreach to citizens and stakeholders. It continues with a three part discussion of the optimal siting , or **location** of the facility, and the resolution of **circulation** issues for both the facility and the surrounding community. These processes yield the information necessary for the proper **selection of type**, with a focus on both form and level of service. In concert with the results of these planning processes, the ultimate costs can be projected and methods identified to **finance** the facility.

Community

Community planning involves ensuring that all stakeholders are satisfied in the conclusion that structured parking is required. It necessarily includes three critical elements; i) the process of enlisting the stakeholders in a visioning effort to assure they get what they want, ii) an accurate projection of the parking demand upon which the solution rests, and iii) an identification of the size of the facility based on its capacity**.**

Process

To successfully build structured parking, the broader community must support it. This cannot be underestimated. Structured parking is a high density use and fosters additional density. Many in the community correlate density with becoming urban, but fail to focus on the positive aspects of urbanity. Density is a difficult virtue to promote in the smaller downtowns of New Jersey and is discussed further in the section on Urbanism. It requires resolve to dispel the belief that higher density makes places less livable. No matter how many examples of Hoboken, Boston or Portland are shown to an audience, many cannot transpose these values on their own communities and structured parking is often a flashpoint. Edmund O'Brien, the Mayor of Metuchen, NJ, describes structured parking using the "d word" (deck, as in parking deck) as if it were a profanity unspeakable to his constituents. To them, even its mention threatens the idyllic village with becoming urban, and urban has only negative connotations - crowding, crime and bad schools – without any of the positive ones – urbanity, amenity and choices.

A critical first step in beginning the development of structured parking is to actively engage citizens in the community design process. This process typically involves a series of interactive meetings called charrettes,[1] where citizens, stakeholders and government officials all confer on the design of a parking facility. Charrettes are typically 'facilitated' by town leaders, the designers of the parking structure, or more often, outside consultants who lend an air of impartiality. To maximize participation, they are typically held on a Saturday and include lunch. In the morning, facilitators present the issues to the group and then subdivide them into design teams. Each team is typically assigned a design professional that can organize the group's opinions on semi-transparent trace paper that is laid over a plan of a downtown. After (or during) lunch, each team elects a spokesperson to present the work to the larger group (the design professional should not represent the group unless unavoidable). The ideas presented are organized as a menu of issues that then become the basis for the structure's design or the subject matter of subsequent charrettes. These subsequent events may further the design process or take the form of 'focus groups', similar to those used in market research, in order to identify the benefits and liabilities of each strategy.

typical charrette

Visual preference surveys (VPS) are an important tool and can be a decisive factor in a charrette's outcome. VPS is a trademarked technique developed by A.Nelessen Associates, Inc. that assists a community in determining which components of its environment or proposed developement contribute positively to its overall image. They are helpful since they provide the public with a broad and relatively inexpensive range of options for depicting community features and a proposed plan or project. As the name implies, the technique is based on the development of one or more visual concepts of a proposed plan or project and submitting those to a ranking according to preference. Preference is often gauged by "succeptibility to change." If a feature of the community is highly valued, it has a low succeptibility; and if undesirable, a high ranking. A degree of variation is also gauged which indicates if a postion is unanimous or if dissent exists. Typical uses of visual preference surveys include helping the community define the preferences for architectural style, signs, building setbacks, landscaping, parking areas, size/scope of transportation facilities, surfaces finishes, and other design elements. Public participation is dependent on the type of visual preference survey technique employed. For example, if a focus group format is used, then some public selection process must be used to include a set of individuals who are representative of the views and interest of the larger community. At other times, the visual preference survey may be included as part of a public hearing or public meeting process, with visual options displayed using projection and rankings culled using a standardized testing process.

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[1] The French word, "charrette" means "cart" and is often used to describe the final, intense work effort expended by art and architecture students to meet a project deadline. This use of the term is said to originate from the École des Beaux Arts in Paris during the 19th century, where proctors circulated a cart, or "charrette", to collect final drawings while students frantically put finishing touches on their work (National Charrette Institute).

There are some potential drawbacks to the use of VPS. It can be time consuming since they may require the development of one or more visual renderings of options or design features under consideration. This set-up time may require several weeks of preparation, depending on the availability of data, the skills of the artist, and the desired size and level of detail for the visual rendering. Additionally, because of the visual sophistication of the public, given the pervasiveness and societal influence of mass media and advertising, there may be expectations on the part of the public for high quality and completeness. The public may dismiss the visual content because the renderings or presentation are not developed to a comparable level of detail and quality they are use to viewing in the print and visual mass media. It is also possible for the public to develop false expectations based on the visual rendering.

The community design process has important symbolic advantages. The process actively involves the public rather than relegating them to the passive role of reviewing prepared documents in a public hearing process. The symbols of a charrette are democratic; all ideas have value and can be freely exchanged and debated among equals. In contrast, the symbols of a typical public hearing are authoritarian. Presentations in public hearings often give the impression that much momentum has already been gained through a process that was developed in private. A subconscious message is transmitted that to change direction will loose momentum. The formal arrangement of participants in public hearings reflects its underlying authoritarian qualities. Typically, a planning board or town council sits like a high tribunal on an elevated platform behind formidable desks. The public must approach a microphone, often after being interrogated by the town's attorney regarding who they are. Intimidated by the formality, many citizens often must read prepared statements. Given this description, it is difficult to imagine how this formality can foster the free exchange of ideas. If anything, it makes citizens feel embattled.

Embattled citizenry exist today in virtually all communities, rallied by outrage directed at the draconian planning processes of much of the 20th Century. It is highly likely that the development of structured parking, however democratic the process, will attract their ire. In many cases their concerns are valid, yet it is the default negative response of many that have earned them the moniker NIMBY (**N**ot **I**n **M**y **B**ack **Y**ard) or CAVE people (**C**itizens **A**gainst **V**irtually **E**verything). Rather than avoiding or shielding the process from NIMBY or CAVE groups, they should be welcome, as they force a community to diligently identify the need of structured parking, carefully study its implications, especially traffic, and go to every extent possible to harmoniously integrate a structure with existing surroundings. In many cases, no response short of abandonment of the project is enough and a legal challenge is filed. A well planned parking structure development process must assume that this will happen, whether opposition appears at the onset or not. All legal protocols must be carefully followed to eliminate the possibility of a legal challenge based on technicality.

In addition to symbolic advantages, the community design process has several practical ones. First, it brings new ideas to the process. The building of structured parking has been finely tuned through pre-fabrication to minimize costs. The negative aspect of this is a 'one size fits all' phenomenon – one that is often blind to the locally specific conditions, such as an important view or how residents circulate. These ideas are important to making a structure fit harmoniously within its surroundings. Second, the community design process is natural marketing tool that raises positive awareness of a project. Being involved in the design gives citizens a pride in ownership that migrates even to those who did not attend the charrettes. To a hesitant local official, the beneficial political windfall can be enormous.

Of vital importance to the successful outcome of a project is the role of leadership. Every project needs a visionary, and someone to champion its cause. Bernick and Cervero (1996) make the case that the successes of two transit villages in the San Francisco Bay area, Fruitvale and Pleasant Hill, are largely due to the influential and impassioned role played by their champions. In Fruitvale, throughout the first half of the 1990's, former HUD official Arabella Martinez headed a local community group (the Spanish-Speaking Unity Council) and was singularly instrumental in raising public awareness, raising funds, and assuring that public safety and economic development incentives were aggressively pursued. In Pleasant Hill, Contra Costa County Supervisor Sunne McPeak became involved in a BART station steering committee in 1981. She championed the transit village cause, spending hundreds of hours at neighborhood meetings and public hearings going over details of the station area plan, playing peacemaker between transit village supporters and city officials, and prodding redevelopment officials to be proactive. She remained committed to the project even beyond when she left public office in 1993.

The implications of the public participation approach can be demonstrated lucidly by an examination of two projects from the list of precedents, Princeton and Westfield, NJ, whose outcomes exist in stark contrast because of the method used to engage the community.

Princeton

At a parking symposium held at Edward J. Bloustein School of Planning and Public Policy at Rutgers University on January 28, 2005, former Princeton Mayor Marvin Reed provided insight into Princeton's political process. He outlined a transparent and inclusive journey that included the following steps:

1. welcoming citizen input;
2. holding plenty of public meetings; and
3. writing a complete Request for Proposal (RFP).

Each of these, he argued, factored heavily into public support of what everyone expected to be a controversial project. By welcoming citizen input, local officials demonstrated a willingness to listen. They formalized the process by holding numerous public meetings to discuss the parking issue and address local concerns. Following these steps, the Borough government wrote a complete Request for Proposals that attempted to compel private developers to respond to what local residents wanted, instead of the reverse situation,

Princeton public meeting

where the community would be forced to quickly respond to a proposal made by a developer.[2]

To help local residents decide exactly what they wanted, Princeton officials hired a consultant to lead a public visioning process. The process began by asking citizens what images they thought represented their community: a bustling downtown with tree-lined streets and a safe pedestrian network, or seas of asphalt lining side streets and alleys. The process demonstrated visually to residents that surface parking lots were consuming a limited supply of downtown land. Illegal parking and faceless side streets were also consequences of the lack of structured parking and poor parking management.

In essence, Princeton was able to choose its own destiny. The Borough avoided the risk of building an unappealing structure that would dissatisfy local residents and prevent the Borough from addressing its parking deficit in the future. In the end, local residents were able to assist in the design of attractive structured parking that they felt contributed to their community.

Spring Street garage / Witherspoon plaza

A critical part of the process that led to Princeton's success was the utilization of the New Jersey Redevelopment Act and the creation of a redevelopment plan for Princeton Borough. By labeling the area in need of redevelopment, the Borough created a plan that was not subject to referendum, a process which has doomed numerous parking proposals throughout New Jersey. Although opponents of the plan brought suit against Princeton, the courts ruled in the Borough's favor, stating that the Redevelopment Act applies to all municipalities, not just struggling urban areas.

Westfield

In 2000, The Town of Westfield in Union County began a process that closely paralleled that of Princeton Borough. A blue ribbon committee was established to analyze long-term parking needs of the community. Parking consultants were also used at various points and recommendations were made to create two mixed-use parking/retail/residential projects on two municipally owned parking lots.

A Redevelopment Area was designated. A redeveloper was selected, but at a time of change in membership on the Town Council. In the face of outspoken opposition, the governing body determined to present the project as a non-binding referendum even though Local Redevelopment and Housing Law specifically prohibits it. Whether many issues (such as if there should even be a parking project; if the parking project can be funded by a General

[2] Parking Symposium, Mayor Marvin Reed Presentation. January 28, 2005. Rutgers University School of Planning and Public Policy.

Obligation Bond; whether it can be self-liquidating; or whether it should be a mixed use project) can even be the subject of a referendum is open to interpretation. Arguably, these are complex issues that are best left to decision making by an informed governing body rather than an up or down vote by referendum. Nevertheless, the result of that referendum was a resounding NO and the project was not pursued.

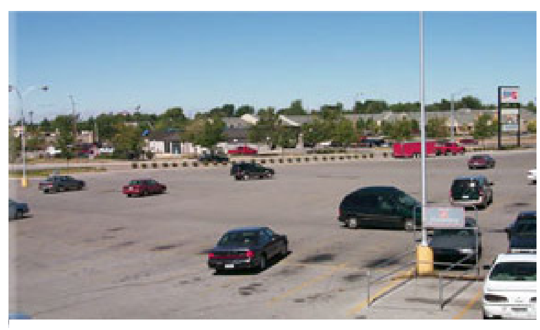
Demand

Parking demand for a specific land use varies widely from one location to another. The variations reflect the density of development, availability of public transportation, local policies, price of parking and local economic vitality levels.

Parking structures are typically contemplated when there is a perceived need for more parking than can be accommodated in surface lots serving a building or activity center. Parking has become an enormous consumer of land and resources. Office buildings in suburban settings typically require 1 sq. ft. of parking for every sq. ft. of leasable space, while shopping centers require as much as 1.5 sq. ft. of parking for every leasable sq. ft. Parking structures are expensive to own and operate; costing up to five times as much as surface parking (Dunphy 2003).

typical downtown surface lot

Conversely, surface parking is usually not the highest and best use of a parcel of land. It is becoming generally accepted that suburban development as practiced in the second half of the twentieth century is not beneficial to the broader community. Far-flung, low-density suburban development cause clogged roadways and a deteriorating quality of life in both urban and suburban areas. Acres of free parking, commonly oversupplied and underutilized, result in a low density of land use that makes public transportation uneconomical, discourages shared parking and increases the reliance on the personal automobile. Parking structures allow denser development or expansion of an existing land use that otherwise would not be possible. According to the Urban Land Institute, a tipping point for developing structured parking is when land values exceed $30 per sq. ft (Dunphy 2003).[3]



….oversupplied and underutilized…

There are a variety of important factors that affect parking demand that are specific to a downtown:

1) Provision of Transit: Downtown areas with extensive transit service experience higher modal splits by public transportation compared to suburban areas. Most parking requirements available in the industry have been developed for locations that have very

[3] According to NJ Transit, this tipping point now exceeds $40 per sq ft. in New Jersey as of 2007.

minimal public transit services. These parking ratios need to be adjusted to take into consideration the actual percentage of travelers arriving by private automobile. The percentages of transit users may vary by trip purpose. For instance, the transit split is generally higher for journey-to-work trips to a downtown area than for recreational or shopping trips to downtown. The US Census provides information on travel modes for journey-to-work trips.

2) <u>Multi-Purpose Travel Behavior</u>: In downtown areas with a mix of uses, travelers generally park once and then during the course of their stay will walk to other destinations in downtown. A typical example is a person traveling downtown for work and then during lunch breaks or after work goes to a restaurant, goes shopping or goes to a gym. The primary use is the e 6-9 DUA tion, whereas the other destinations may be considered secondary. Other examples may be business trips or trips to a convention or a special destination retail use as the primary purpose. The parking requirements for the secondary uses will be significantly less than typical suburban ratios. For the Borough of Princeton, NJ, a study done by Alan M. Voorhees & Associates in August of 1979 established the parking ratio for retail uses was estimated at about 2.1 spaces per 1000 square feet of leasable floor area, about half of what it would be in a suburban environment. The park-and-walk behavior in a downtown area or any town center is a very desirable pattern because it allows the parking demand to be satisfied in one larger facility, often at a location that can accommodate the traffic loads, and it encourages pedestrian activity, thus enhancing the overall vitality of that area. This behavior allows the parking supply in the more central area to be decreased thus reducing also the traffic impacts. The Town of Manchester Center, VT established park-and-walk lots on the fringes of their retail area capturing the traffic prior to getting into the most congested area. It is not certain that in the case of Manchester Center where all retail uses would be considered primary destinations, the actual parking demand is lower than typical suburban standards. The major benefit of the park-and –walk pattern in this case is the reduction of traffic impacts in the retail area, the reduction of auto-pedestrian conflicts along the sidewalks in the center, and the greater pedestrian activity caused by the substitution of auto trips with pedestrian trips.

Manchester Center signage

3) <u>Shared Parking</u>: Whenever several uses are located on one site or within a downtown or smart growth area, there is the opportunity to share some of the parking spaces and to reduce the needed parking supply. This is due to the fact that not all uses have their peak parking demand occurring at the same time. For example, office uses have their peak demand on weekdays from 9 AM to 5 PM (the afternoon parking demand of offices actually tends to be slightly lower than in the morning), residential uses peak during the night hours, retail uses on Saturdays or evenings, etc. By using the same parking facility for the different uses the overall supply can be reduced. This benefit can be achieved at the level of a development site with a mix of uses or in a downtown area. Table 22 shows an example of such a shared-parking calculation for downtown Saratoga Springs. If each use were to provide for its own parking demand in a separate facility – the typical suburban pattern where each use needs to satisfy its own peak demand - a total of 3,029 spaces would be required. Under the shared-

parking scenario the greatest total demand is 2,258 spaces, occurring during the evening hours. The 25% reduction in parking spaces translates into a $14 Million savings. The other advantage of shared parking facilities is that by combining parking in larger facilities, parking design, operations and control can be improved. However, to take advantage of shared parking, no spaces can be reserved for individual parkers or for groups of parkers.

A successful shared-parking facility was built in conjunction with the private Palmer Square mixed-use development Princeton NJ. The long-term parkers (residents and employees) share the upper level of the privately built parking deck, and the short-term parkers use the lower level. The lower level is controlled by gates and is open to the general public. Even though the townhouse units are fairly upscale, the residents do not have reserved spaces. With the completion of the last phase of Palmer Square, the parking decks will be completely wrapped by mixed-use developments.

The inefficiencies of reserved parking spaces can be seen in many large residential developments where there are always vacant parking spaces (there are always some residents on vacation or traveling), yet there may not be enough parking for certain groups at certain hours such as the visitors to the apartments. The parking supply in a large residential development could be reduced just by eliminating the reserved spaces.

Shared parking can be implemented by changes to the zoning code and by government policy to allow and encourage it, with sharing arrangements made between individual facility developers or when the City takes the lead in satisfying the parking demand in public parking facilities, either by not requiring any parking or by requiring in-lieu payments. To facilitate shared parking among several property owners, the municipality should allow off-site parking and should allow the required supply to be reduced in accordance with generally accepted shared parking methodologies. These have been established by the Urban Land Institute and the International Council of Shopping Centers in Shared Parking, second edition, (Smith 2005). Off-site parking could be accommodated in a short walking distance of 800 to 1000 feet from the project site (subject to approval by the Municipality).

In-lieu parking fees (payment of a per space fee in lieu of providing parking) can be an effective tool to implement shared parking. The municipality would collect the in-lieu fees and use them to built a municipal/shared parking facility. The in-lieu fees can be set such they become an attractive alternative to providing on-site parking. To encourage the establishment of smaller businesses in a downtown area, the fee could be relatively low for the first 5 spaces needed, then they would increase for larger developments.

Capacity

Planning for the capacity of a parking structure requires more than simply the number of spaces it contains. An accurate parking demand analysis might yield a target of spaces required, based on peak period requirements. This base number can be impacted by including appropriate shared use opportunities as identified in the section on Location. Buffer factors should be included to calculate effective supply – the acknowledgement that the number of spaces effectively in use at a given time is less than the total number of spaces available due to users circulating in the structure and transitioning in and out of spaces. Additional factors, such as the geometrics of parking (vehicle sizes, vehicle sales trends, selecting a standard 'design vehicle') and the selection of a specific circulation system type appropriate to the use, also have major impacts on capacity.

As important as the number of spaces required is the ability of those spaces to be accessed satisfactorily and efficiently by patrons. Parking patrons who become frustrated due to inability to locate an acceptable space efficiently, who experience unacceptable delays, or have difficulty finding their way, are likely to park elsewhere and avoid returning. This efficiency of space usage can be measured mathematically as Capacity Flow, and the target number of spaces adjusted accordingly. Accurately projecting a facilities capacity flow is a function of its peak hour volume, and the volume handling capability of various functional elements within the structure. See Table 8 for peak hour volumes by land use, Table 9 for the flow capacity of circulation elements, and Table 10 for functional system capacities for a variety of usage, types, and conditions.

Location

Locating the facility is ultimately a function of three inter-related issues. The first is the local land use patterns and plans for the community, the second is the identification of shared parking strategies as already discussed, and the third is the integration of mixed use programs in the project.

Land Use

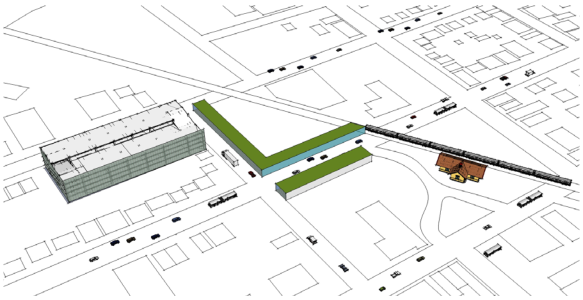
There is no typical land use code associated with downtown parking structures, however, they are typically constructed within commercially zoned areas under the "C" heading such as General Retail Commercial Center Districts. These are often derived from the boilerplate ordinances provided by the American Bar Association (ABA 2004) or commissioned by municipal ordinance writers such as the Municipal Code Corporation (MCC), who have recently produced ordinances for the New Jersey communities of Hamilton, Randolph and South Brunswick. These codes often dictate off-street parking standards for distinct uses and have historically overlooked shared parking arrangements that can arise in mixed use developments. These typically originate from Institute of Transportation Engineers (ITE 2004) standards which , in New Jersey, are then adopted as Residential Site Improvement Standards (RSIS) standards, the basis for establishing parking requirements for all residential projects. RSIS ratios can be lowered where it can be demonstrated that local conditions would permit feasible solutions with lower ratios. Presently there is great focus on the applicability of RSIS ratios in mixed use developments, with the intention of that focus being to ultimately reduce ratios. It is possible, and sometimes appropriate, to abandon RSIS. There are exceptions, which legal counsel need interpret for a municipality, associated with the separation of uses that make this appropriate. Successful New Jersey examples of this approach are the Spring Street Garage in Princeton and operations of the Morristown Parking Authority and the New Brunswick Parking Authority.

Shared Parking Near Transit Stations

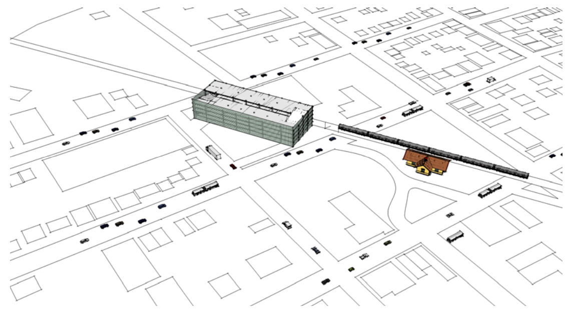
Residential uses represent a typical complementary use in a transit parking project as its parking demand characteristics are similar (low turnover, longer stays, familiar users) and complementary (peak demands at opposite times of day). However, two issues need to be taken into consideration, the first of which is the issue of conflicting commuter schedules whereby the park-and-ride commuters may arrive prior to the residents leaving by auto. This is often the experience in many suburban New Jersey communities, where existing parking lots at train stations fill quite early in the morning peak period. The conflict depends to some degree on the location of the TOD in regards to the major employment centers that are being served by the transit system. For locations that are further away from employment centers the conflict may be more severe, since the park-and-ride commuters need to catch a train fairly early. For example, in Princeton Junction where the majority of the rail commuters are expected to travel to downtown Newark or Manhattan and the future residents in that TOD that do not commute by rail may drive to employment destinations in the Route 1 corridor or at Princeton University, the scheduling conflicts may be significant. These conflicts can be addressed quantitatively by undertaking parking occupancy surveys in commuter lots and in residential developments at similar locations. One way to address this issue would be to restrict parking garages that are primarily used by residents to late commuters only, by opening these garages to the commuters and other travelers only after 8:30 AM and thus satisfy the late peak.

The second issue is that a certain percentage of the TOD residents will commute to work by transit and will leave their car in the parking space. The daytime vacancy rate of a residential development near a transit station is lower than for a remote residential development. The fact that car ownership tends to be lower near a transit station is obviously an advantage, however, it does not help in the sharing opportunities.

Regarding proximity of the structure to the transit node, care should be exercised as to its optimized placement. It is not enough to simply put the structure where land is available. Fruin (1987) show how far commuters are willing to walk to a station, and can be related to various levels of service (LOS). For projects that integrate retail into their construction, or that are part of a larger urban development project that incorporates retail establishments adjacently, there is an advantage to placing the structure at some acceptable distance from the transit node. The commuters foot traffic between the parking structure and the transit node can be a positive economic generator for the retail establishments on the path, and can help realize the economic success of those retail participants, and therefore the economic viability of the entire project. In contrast, a parking structure built immediately adjacent to a station that deposits its parking clientele directly onto a platform, while entirely convenient for the commuter, generates no such economic leverage for the project and adds little to the street life of a hopefully bustling transit village. The following illustrations demonstrate the opportunity for the placement of retail in the commuter path, and the opportunity lost in service of commuter convenience.



commuter foot traffic directed through retail



convenient; but yields a deadened streetscape and provides no benefit to finances

As already discussed, a general belief exists that in certain markets, residents expect to have reserved parking spaces, and that a residential developer (especially luxury apartments or condominiums) have to offer them. The advantage of reserved spaces is that it is self-enforcing (residents raise hell when somebody parks in their space), but the disadvantage is that it is less efficient even within one residential development and it does not allow sharing of the spaces. It is not certain to what degree this market perception is real or just a result of entrenched practice. Examples exist of more high-end residential developments that have shared parking (Palmer Square in downtown Princeton) or where attendants park cars wherever they see fit. Municipalities may consider prohibiting assigned/reserved spaces in certain instances in order to make sharing easier and reduce the overall parking supply needed. This could be a condition for a TOD.

<u>Mixed Use Opportunities</u>

The most effective strategy to enhance the viability of structured parking is to use the same parking facility for many different uses. This practice positively impacts a structure in at least three ways; size, security, and financially.

First, by combining program uses whose demand characteristics are complementary, the overall parking demand peaks and valleys associated with individual uses are smoothed. Taking advantage of shared parking synergies results in lower parking ratios and an optimized overall parking supply. Ultimately, a parking structures' size is minimized or conversely the development opportunity around it is maximized. In downtown locations, the uses that best complement commuter parking are housing, retail, entertainment and institutional.

Second, structured parking has many negative associations because of its often massive size and incongruousness, combined with the public's perception of it as unsafe. As a result, parking structures are not entirely welcome in many communities; and when they are, they should be "used but not seen." Blending other uses has several benefits: First it softens or even obscures a structure's sheer bulk, second, it brings more people to it, making it feel more safe and third, when street-front retail is included on a parking structure's ground floor, it enhances the life of the street or its streetscape.

Princeton streetscape at Spring Street garage / Witherspoon plaza

Finally, the financial viability of parking projects increases with the inclusion of additional uses. Since parking is difficult to finance and commuter parking is rarely self-liquidating , the additional revenue stream associated with the sale or leasing of residences, leases from retail or other commercial tenants, or the sale of development rights, often makes the parking project viable. On property owned by a municipality or transit agency, building structured parking can liberate property for other revenue generating development.

Circulation

Planning for circulation occurs at several scales. One scale addresses access to, and within, the facility itself, for both vehicles and pedestrians. The second scale addresses the impact of the facility's portals on the surrounding community, and their impact on local traffic patterns.

Access

gated portal with PARC equipment

Regarding access to and from the structure itself, consideration need be given to both vehicular and pedestrian access. Vehicular access considerations include whether the structure is gated or non-gated, what form of Parking Access and Revenue Control (PARC) system will be employed, how many lanes will be required to handle peak loads, what configuration of each lane is required to ensure the PARC system works as intended, and whether there are any special design requirements such as event parking egress.

Ungated facilities offer the advantage for easy commuter exit of at peak periods. They are also most cost-effective system when solely used by commuters who pay monthly to display stickers or hang tags. For infrequent users of these facilities, a flat fee, pay-by-space system is often provided with systems ranging from slot boxes or parking meters to pay and display systems that can accept payment by cash or credit card for parking at for any length of stay. All such systems require payment on arrival at the parking facility and enforcement through the ticketing of violators. The disadvantage of an ungated facility is that it needs to be enforced and if the facility is shared between commuters and residents, it needs to be enforced during both peak periods.

typical POF station

Increasingly, many facilities are gated, which do not require enforcement, and use some form of automated PARC system. Regular users of these gated facilities, including residents, downtown employees and commuters, pay using a variety of card system technologies, such magnetic stripe or proximity cards. For irregular parkers and downtown customers, the old standard of pay at exit to cashiers is rapidly being replaced by pay-on-foot (POF) systems. With POF, the parker pays "on foot" at a machine upon returning to the facility, but before retrieving the car. An "exit ticket" proving payment is issued to the parker, who has a predetermined period of time to return to the car and exit, surrendering the exit ticket to open the gate.

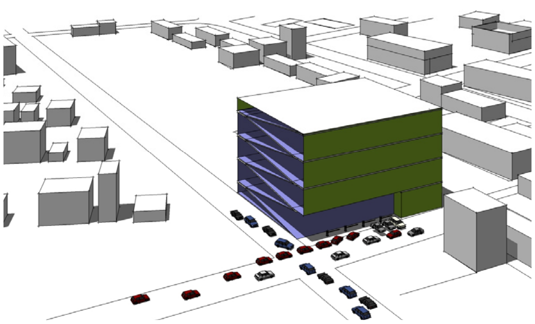
Several emerging technologies may become mainstream PARC systems in the near future. These include automatic vehicle identification (AVI) such as EZPass and license plate recognition (LPR). Swiping a credit card for identification, as one does for an airline e-ticket, which can then be billed for payment, may obviate the need for both a POF and swipe card system, but because of the high rates of failure of magnetic stripes, an alternative payment method must be present.

Local Traffic Impacts

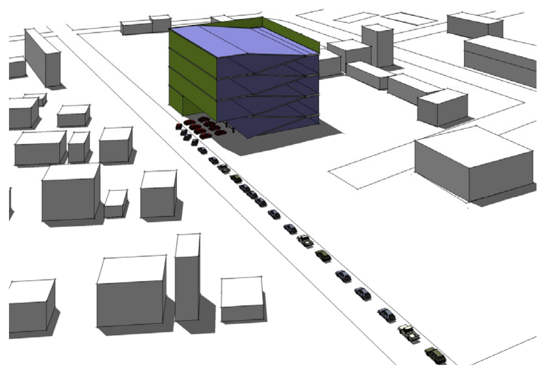
Several issues should be considered when assessing the traffic impacts of a new parking structure on a downtown. These include specifying the appropriate location(s) of driveways and gates, the anticipation of problems that may result from changed traffic generation rates, and congestion which may need to be mitigated.

Driveway / Gate Placement:

For access to a parking structure, a lower level roadway (i.e. a side or secondary street) is generally preferred over a higher facility roadway (i.e. a major or primary street) as it is less important in the overall flow of traffic through the community. Placing access points on a secondary street will lessen the potential disruptions from queued vehicles waiting to enter the structure. Driveways should be placed mid-block on these secondary streets and away from intersections to maximize queing space there during peak period. While the queuing of vehicles on the street might be undesirable, it is preferable to a queue extending into a neighboring intersection, where it degrades the efficiency of the surrounding street network to handle peak hour traffic and hamper safety. Along with driveway location, the placement of the gate with respect to the structure's facade and the type of processing equipment is an important consideration. If the gate is placed within the structure, some queue space may be accomdated there, but at the expense of spaces within the structure. This trade-off is advisable if a slower type of gate processing is used (e.g. a manual transaction with a gate attendant) or location proximate to an intersection is unavoidable.



to be avoided



for demonstration only - depicts queue handling availability

Traffic Generation Rates:

The amount of traffic generated by a mixed-use development with structured parking can vary by a great deal. The amount of mixed use parking spaces, combined with the size of the development, and the mix of land-use types within the development can all dramatically affect the number of vehicle trips generated. It is important to remember that these developments are not typical of those used in developing trip generation manuals, so these manuals should be used with caution and special considerations should be made for the specifics of the proposed development.

To calculate the traffic generation of a mixed-use development, the analyst needs to take into consideration the trips that stay internal to the development, i.e. trips made between the various uses in the development and made on foot. As an example, consider a mixed-use project that includes 20,000 SF of retail space, and attracts X amount of vehicle trips using base ITE (2004) rates. If one of the mixed uses in the development is, say, 200 apartments, then a certain percentage of the X trips come from the 200 apartments, and would be made on foot. This should be deducted from the traffic estimate. The ITE has recommended a particular methodology to estimate the amount of internal trips. The overall percentage of internal trips can vary significantly (depending on the type and number of different uses, and on the size of each use). It is not recommended to take a flat percentage credit for internal trips. Instead each potential trip linkage needs to be analyzed separately and an estimate of internal trips needs to be made for each potential linkage.

For the purposes of estimating the impact to local traffic, the amount of trips generated by an existing site should be removed from the background traffic estimates before trips generated by the new development are added. In some cases, where an existing surface parking lot is replaced by a mixed use development including both residential, commercial, and commuter parking, the overall effects on the peak hour traffic flows may be quite small.

Another way to estimate the impacts of a new parking facility is to use traffic generation rates based on the number of parking spaces, or based on the peak-hour entry and exit ratios for various types of garages. See Table 23.

A survey of the users of existing surface lots along a transit line, the existing users of a transit station, and other residential developments in the surrounding community is advisable to better estimate many of the above issues. Marketing studies to determine the potential customer base are often done in the feasibility assessment stages of larger retail developments (such as grocery stores or hotels). These studies can provide very good estimates of the direction of travel to and from the site for the related retail generated trips.

Traffic Congestion Impacts/Mitigation:

The impact of the transit schedule on present and future roadway congestion must be considered. On a train line with less frequent service, commuters typically arrive in clusters before the scheduled service (AM peak), and exiting traffic will be clustered just after the arrival of a train (PM peak). This frequency of transit service bunches traffic into short time periods within the peak periods. This condition has a greater impact on intersection and roadway levels of service than if the same number of vehicles are distributed more evenly across the peak hour or peak period. However, since these surges are usually short in duration, it may not be sensible to use higher peak hour factors in the analysis of traffic impacts because their use, while resulting in wider roadways and increased intersection capacity for the briefest worst case, will have a negative impact on pedestrian friendliness.

As the rate of traffic flow in and out of transit related developments is generally highly peaked around the arrival and departure of the train, it is thus a very good candidate for signal actuation. Actuation allows the signal to add extra green time to the side street only when needed, and the overall performance and efficiency of the traffic signal is improved over a fixed time signal.

Generally, the entry or egress capacity of a parking structure should never exceed the capacity of streets leading to and from the facility. However, larger structures have the potential to add many more additional vehicles to the street network, and various improvements – not necessarily vehicle capacity ones - may be needed. These could range from sidewalk improvements to street geometry improvements to the installation of new traffic signals. Regulations may vary by local and state governments, but generally any degradation in traffic flow levels of service must be mitigated by the developer. As a result, the cost of potential traffic improvements should be considered in cost estimates for the development.

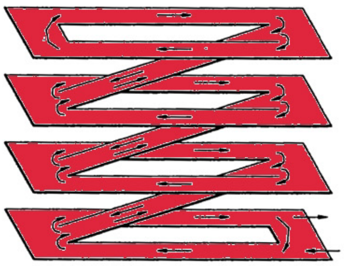
Selection of Type

Selecting the appropriate type of structure, to provide the best solution for a given community, is a function of two inter-related subjects. The first is the choice of form. Form is influenced by both the external environment – determining whether a structure will be open, enclosed, underground or robotic – and by its internal circulation pattern. Directly impacting form is the level of service desired for a facility.

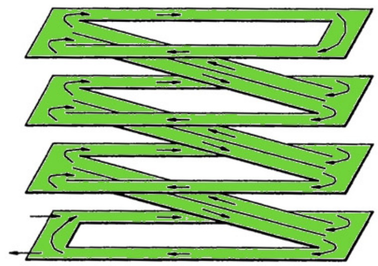
Form

Common circulation types are given names that relate to the pattern of traffic flow and the number of parking bays, and include such types as single threaded helix, double threaded one-way, double threaded two way, end-to-end helix, double end-to-end helix, and camelback helix. When size considerations and construction specifics are included, they can take on name combinations such as three bay side by side, four bay side by side, split level one way, and split level two way. A schematic drawing from Chrest (2001) summarizes these type combinations on the following page.

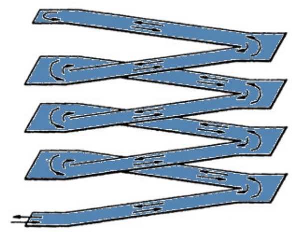
The threaded helix is the most common type used in downtown locations where space is limited. This type requires a rectangular space that is minimally 125 ft. x 250 ft.. Where additional width is available, an additional bays in 60 ft. increments can be added. Where additional is available length another type can be selected or a ramp's slope can be made more gradual, which gives a better Level of Service (discussed in the next section). A ramp with no parking along it is known as an express ramp. In downtown locations, these add cost and should only be planned because of 1) the need to quickly rise above other uses at grade (such as retail), 2) an awkward parcel or limited space, or, 3) the structure is very large or has unusually high peak entry or egress volumes.



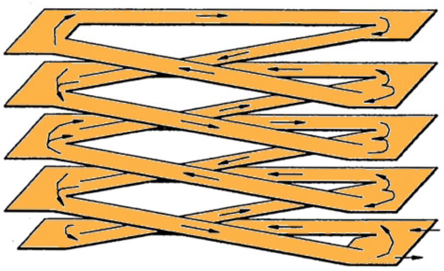
Three - Bay Side - By - Side



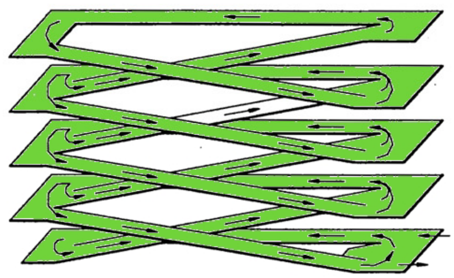
Four - Bay Side - By - Side



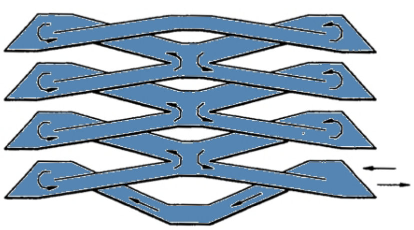
Single - Threaded Helix
Two Way



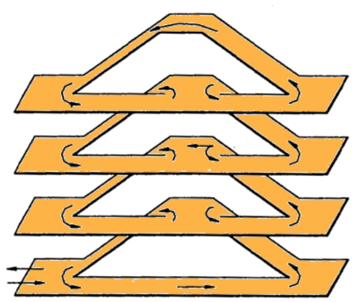
Three - Bay Double - Threaded Helix



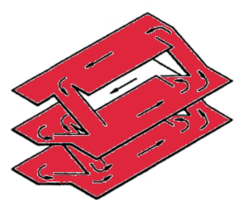
Three - Bay Interlocked Helix
(Single – Threaded)



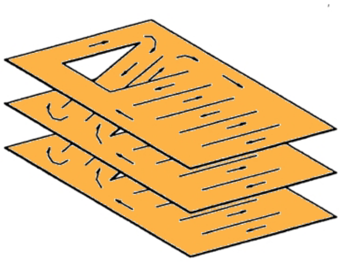
End - To - End Helix



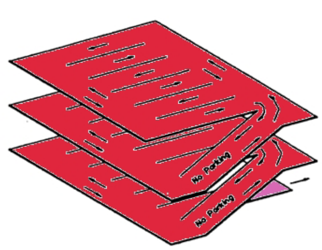
Camel - Back Helix



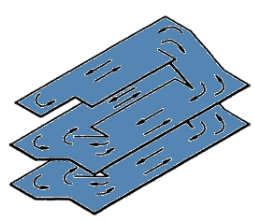
Split - Level
One Way



Large Footprint
Single - Threaded
Parking Bays



Single - Threaded
Exterior Express Ramps

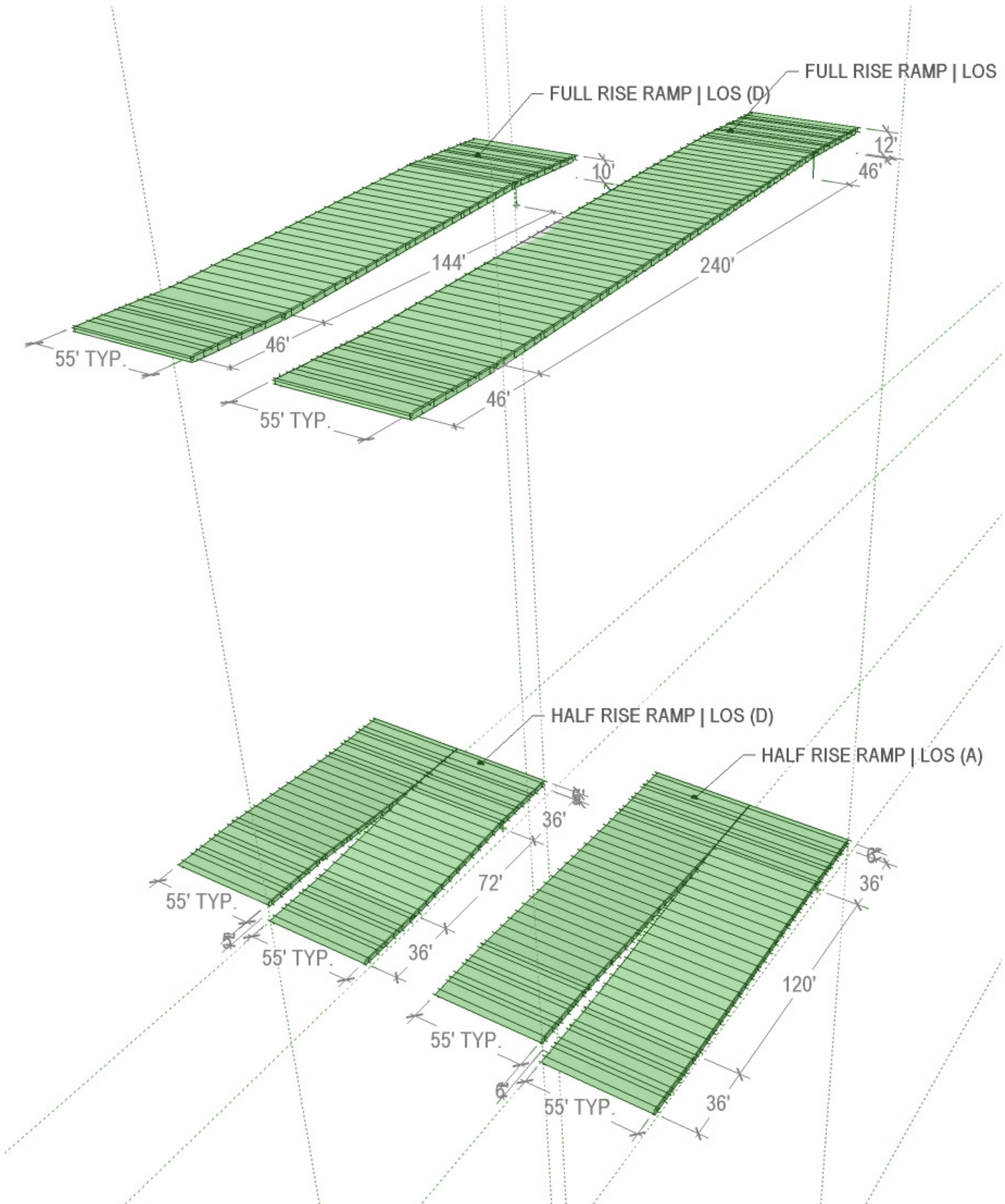


Split - Level
Two Way

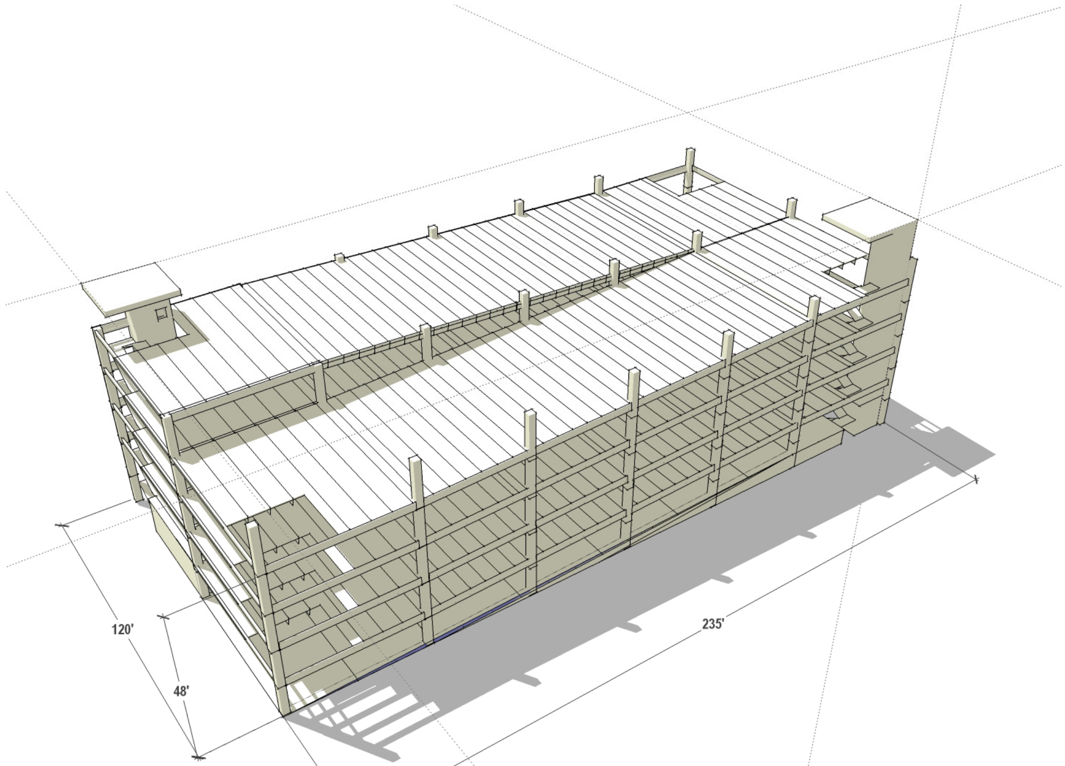
Levels of Service

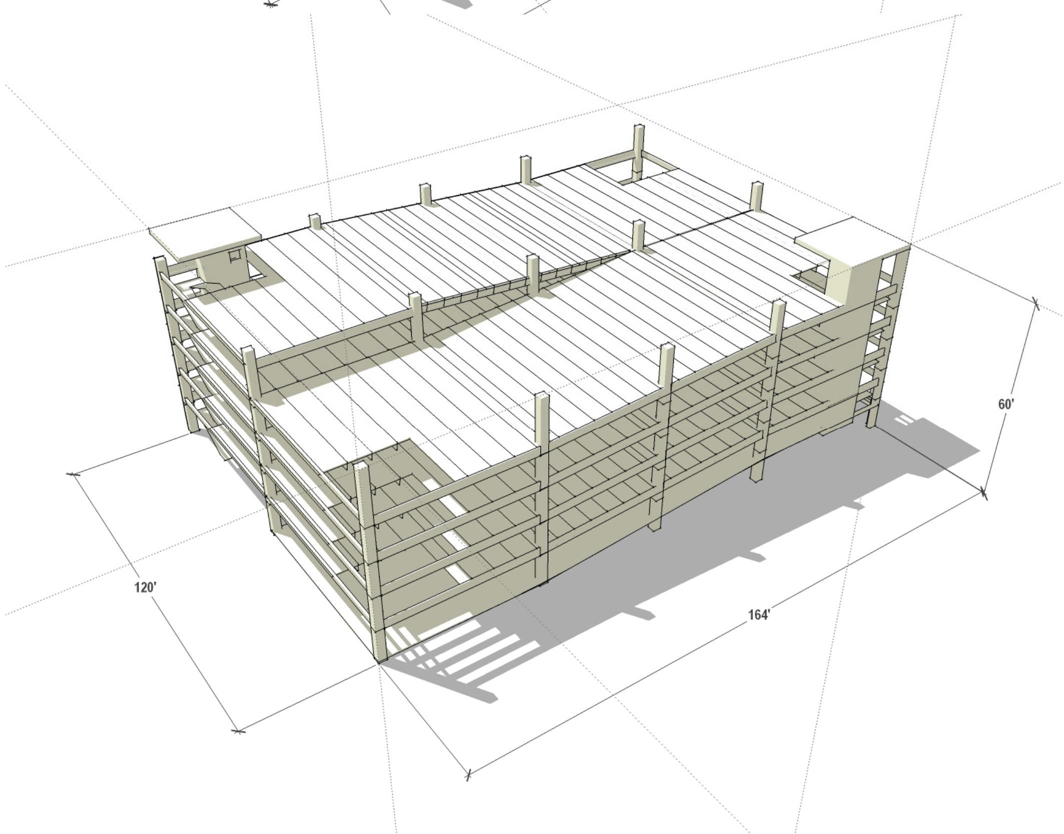
Selecting the appropriate Level of Service (LOS) is a critical step in planning parking structures because LOS affects size and thus impacts cost. LOS as it pertains to parking structures is modeled after the system of classifying roads originally developed by traffic engineers and reflects the acceptability of a number of parking structure parameters to users. The system describes acceptable levels of service by alphabetic designations, with A being the greatest, and D being the least. For parking structures, the parameters include ramp slope, the percentage of spaces on flat floors, clear height, travel distance (number of spaces passed), flow capacity, entry/exits (number), maximum walking distances, maximum distances to an open side, and light court/yard width to height ratios.

No single LOS is universally applicable or appropriate and differing circumstances will dictate differing LOS. The familiarity of the user and the turnover rate of the facility are also major factors in selecting an appropriate LOS. A facility used exclusively by commuters or employees, which has a high ratio of familiar users and low turnover (bursts of activity at the morning and evening commutes with little traffic in between), may dictate a lower LOS than one which has sustained traffic throughout the day by users who may be unfamiliar with the garage (shoppers). It may be desirable to route users past many spaces if they are unfamiliar with the facility, but for daily users, a premium will be on rapid access and egress, thus minimizing the number of spaces passed. The parking public is more likely to be tolerant of lower LOS in settings that are urban and congested. Table 4 describes the consideration of these criteria. The sequence of illustrations on the following pages demonstrates the impact to dimensions (and thus the amount of land required) for a variety of structure types at the greatest and least LOS (Chrest 2001).

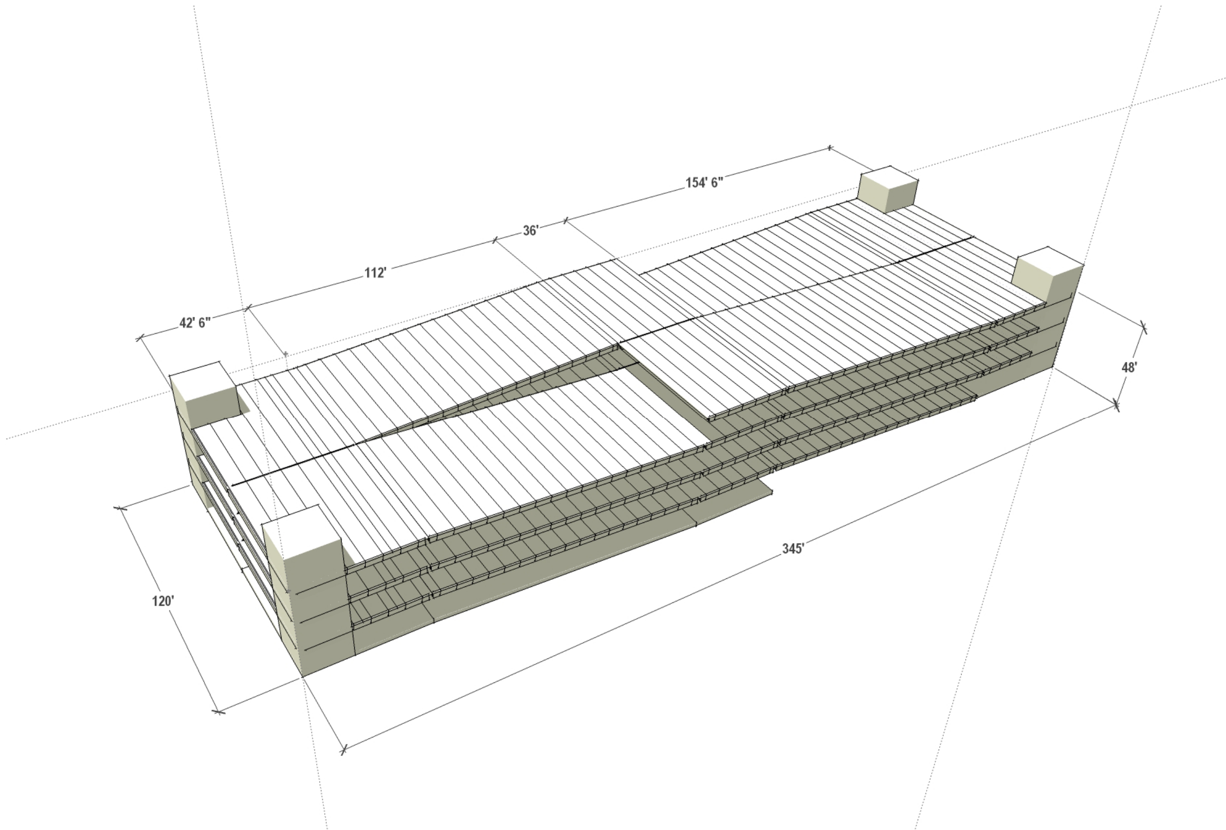


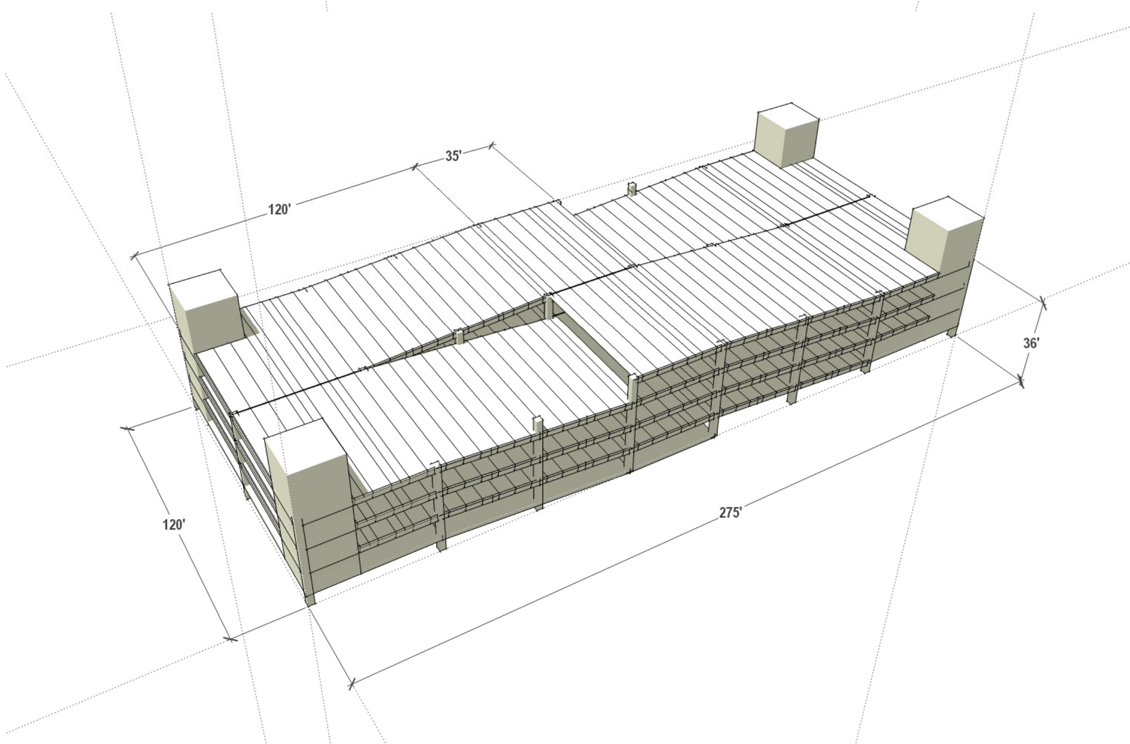
LOS contrast: A above, D below



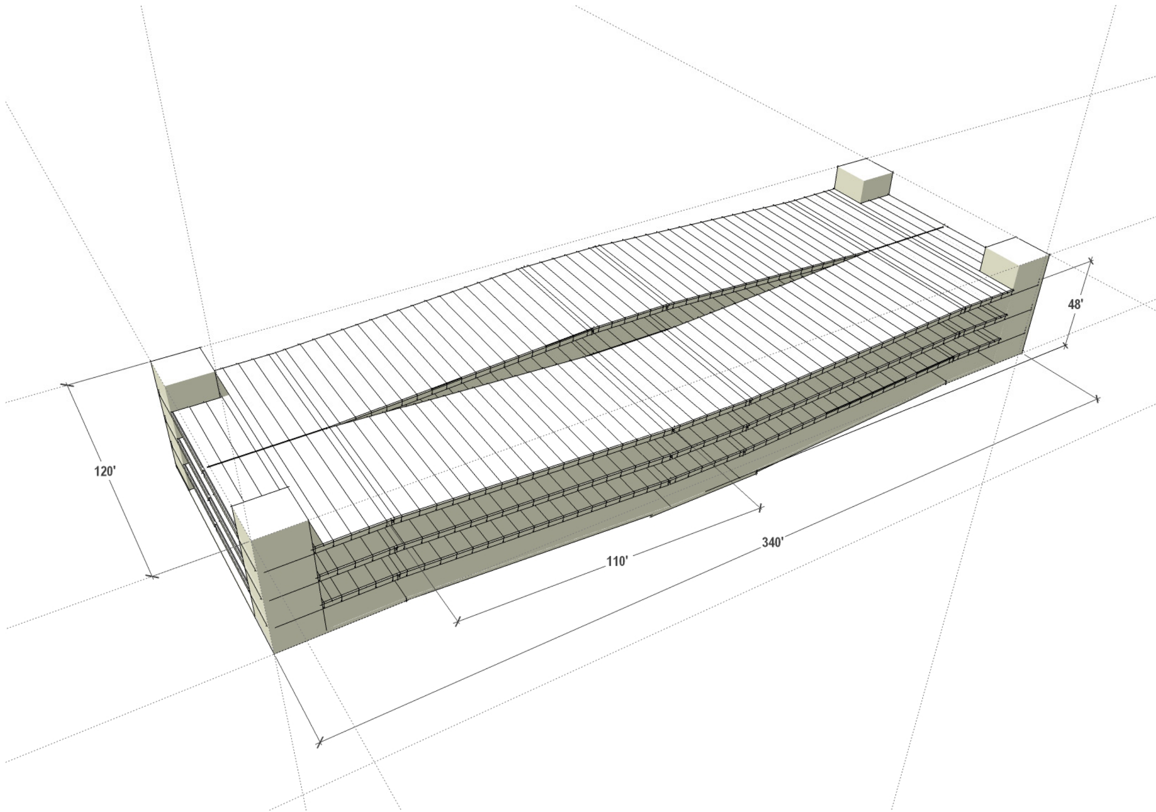


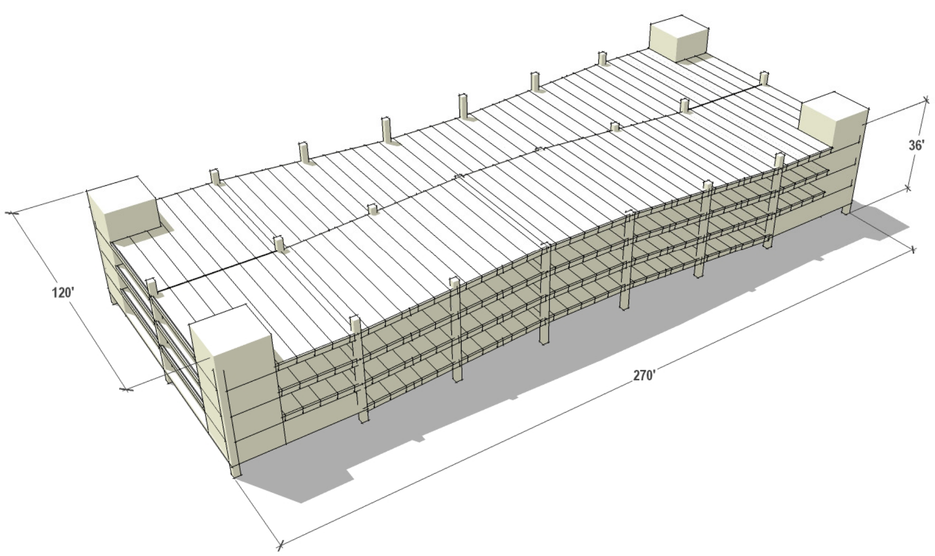
Single Threaded Helix (A & D)



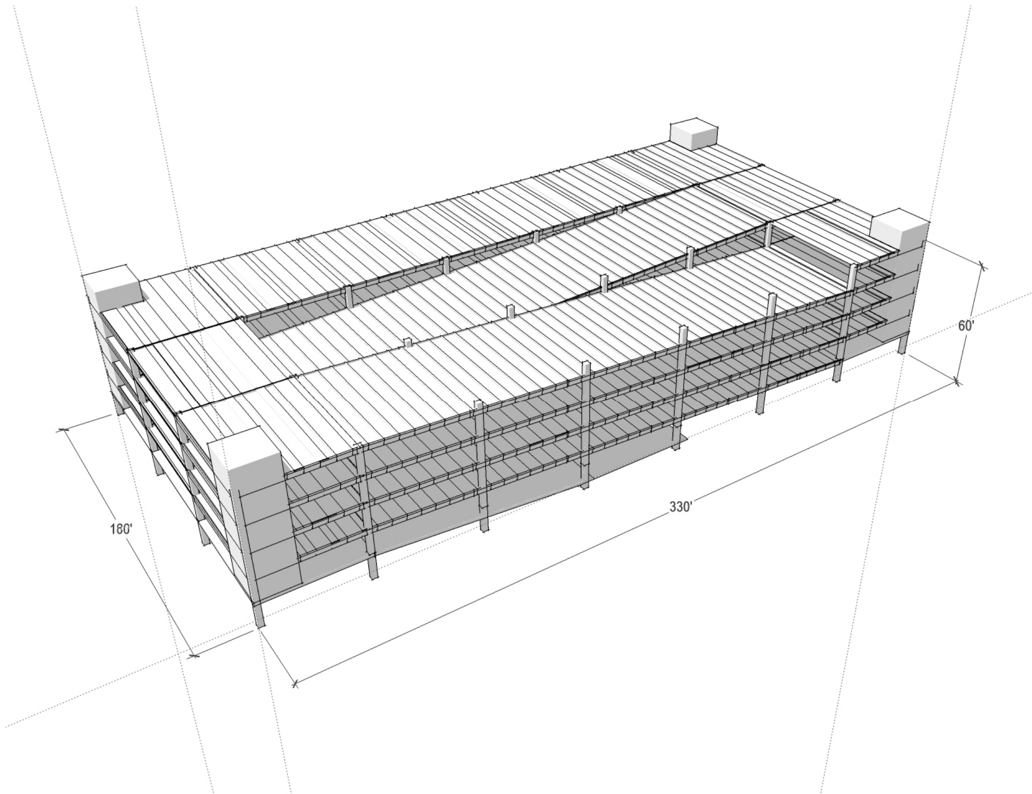


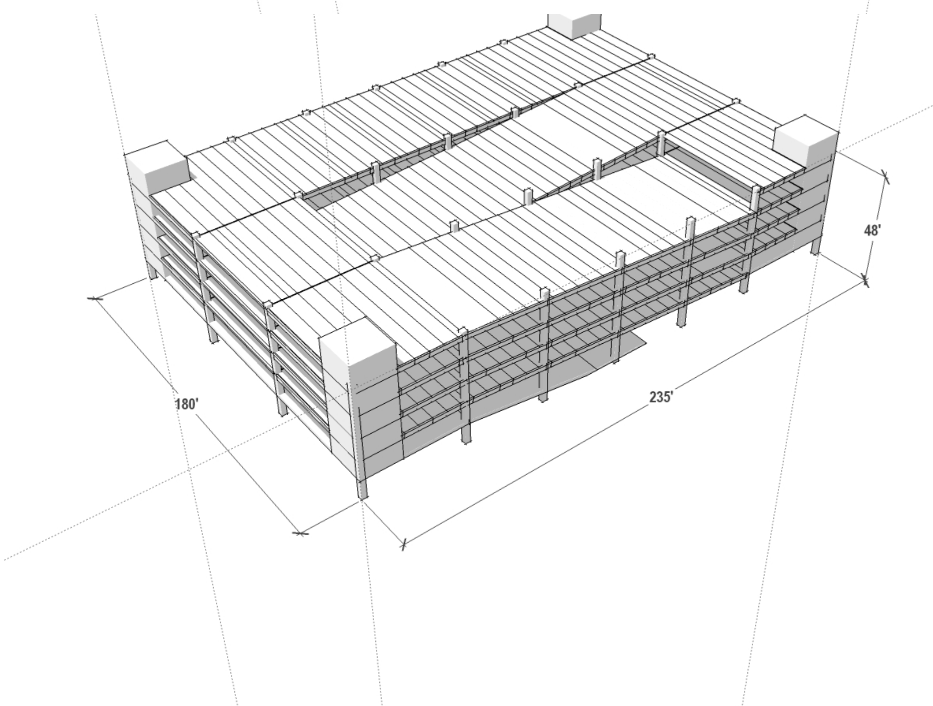
Double Threaded Helix (A & D)



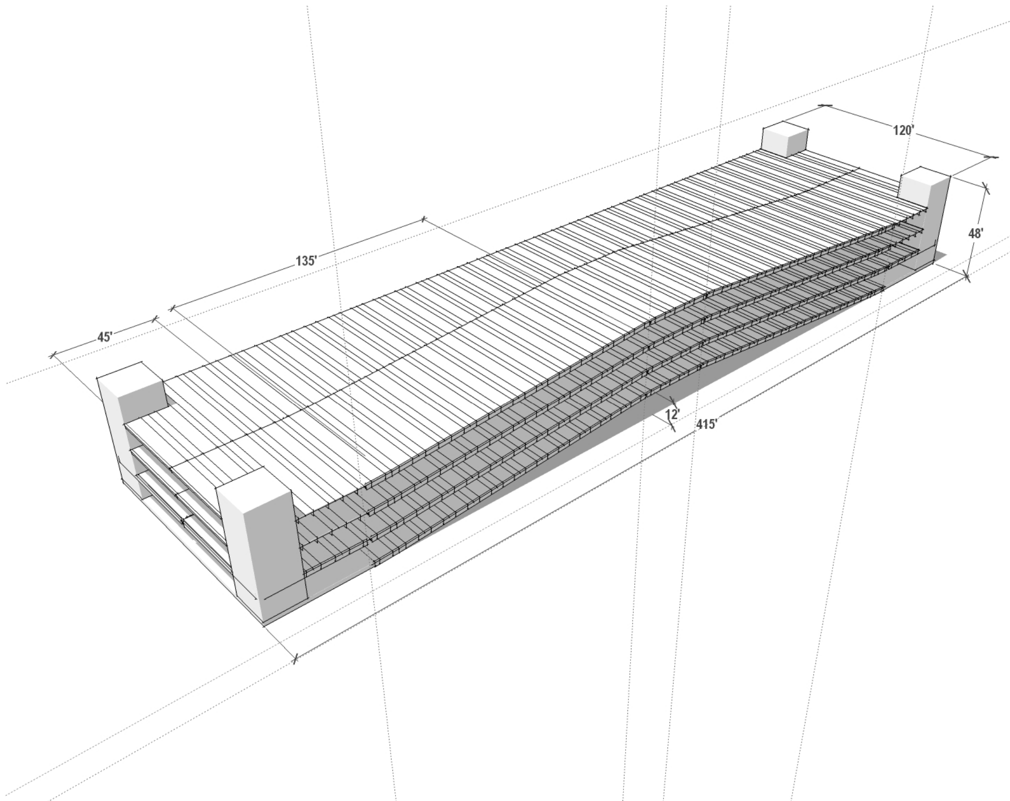


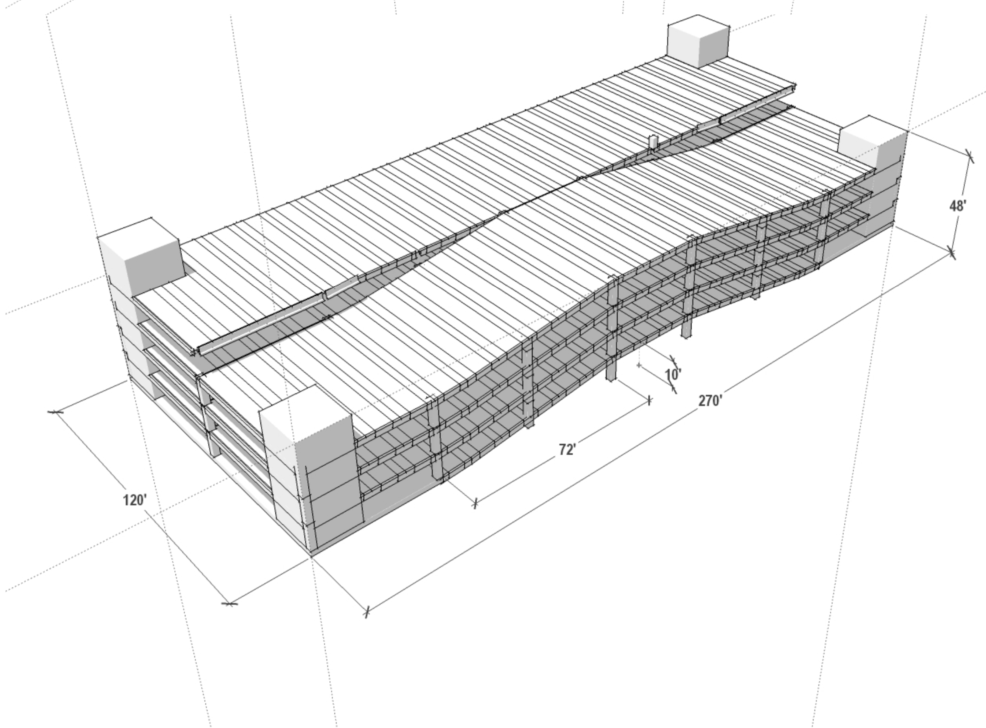
End-to-End Helix (A & D)



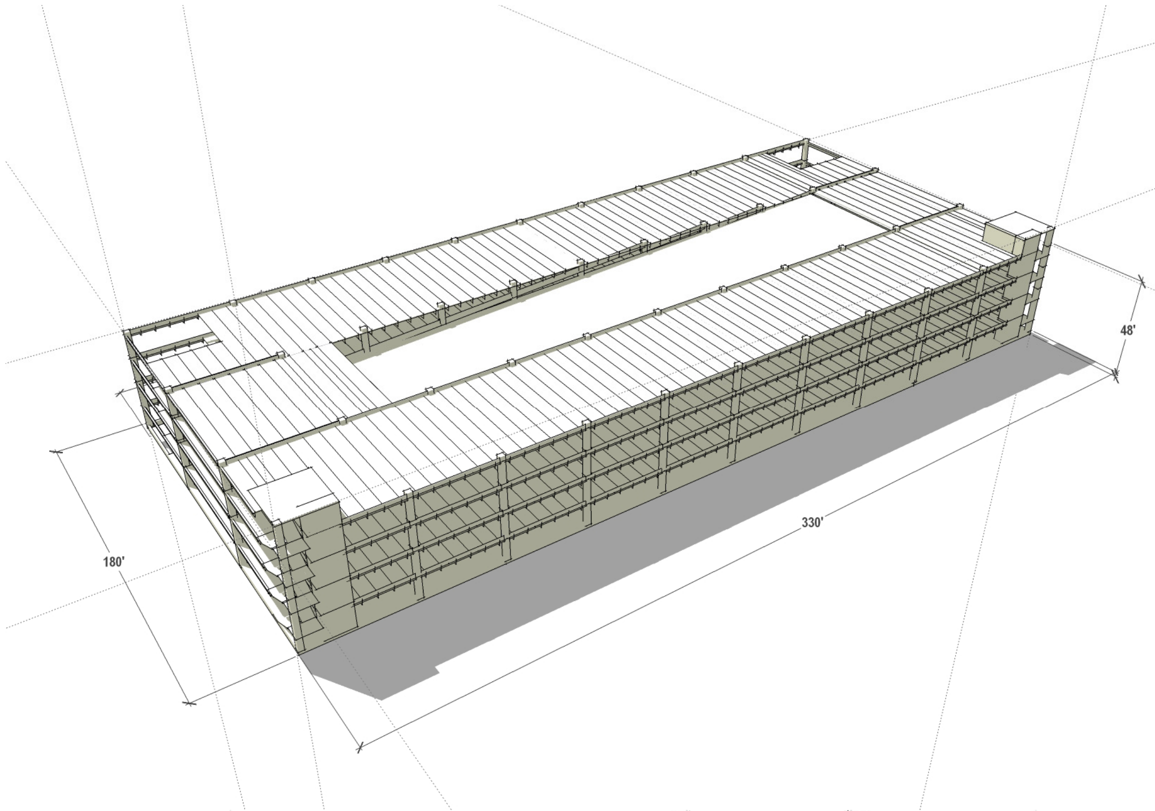


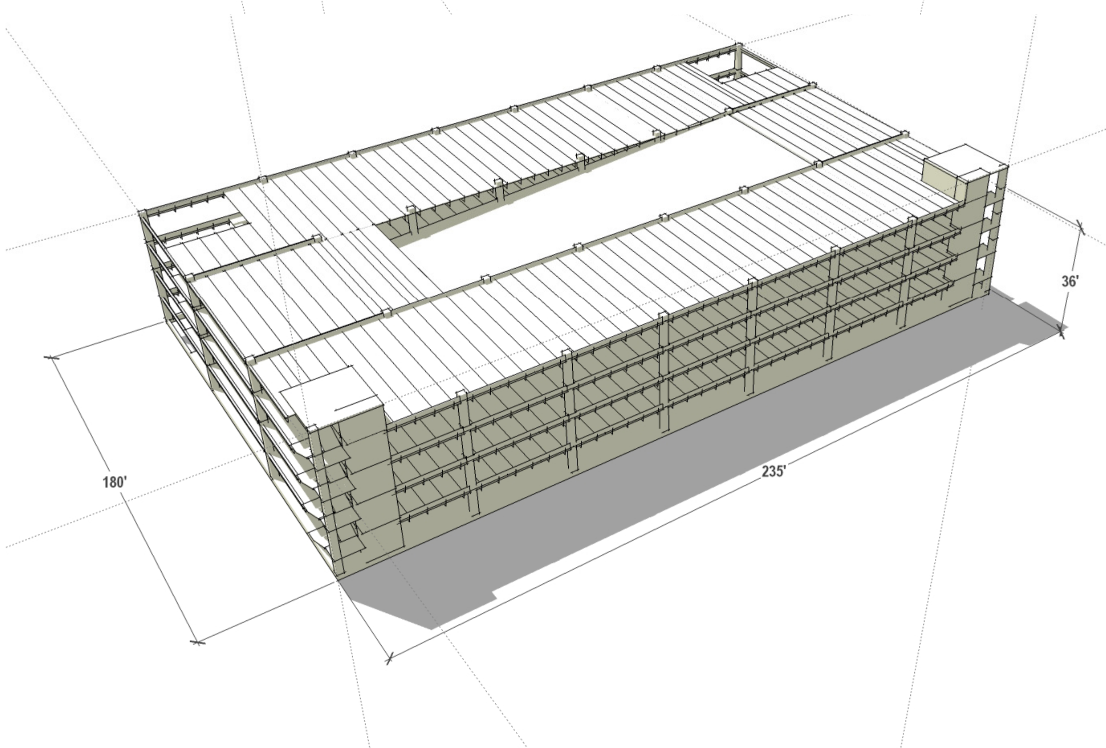
Double End-to-End Helix (A & D)



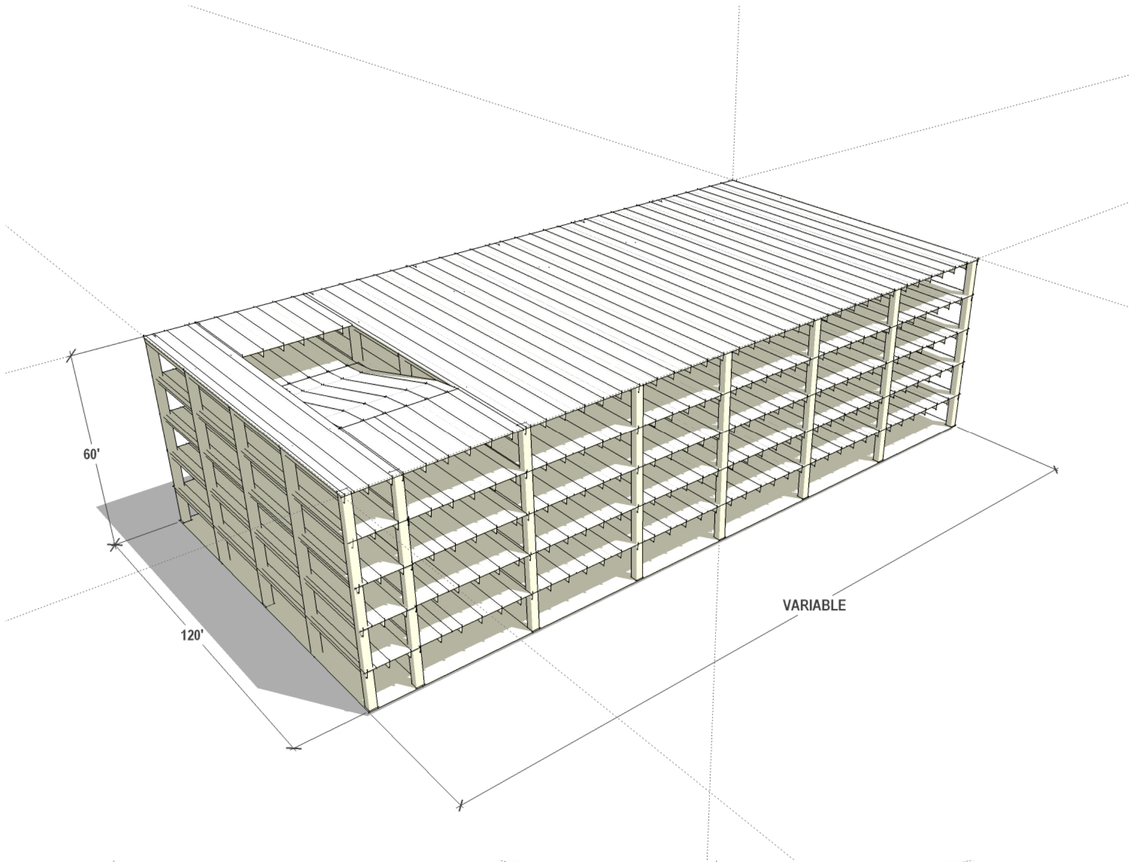


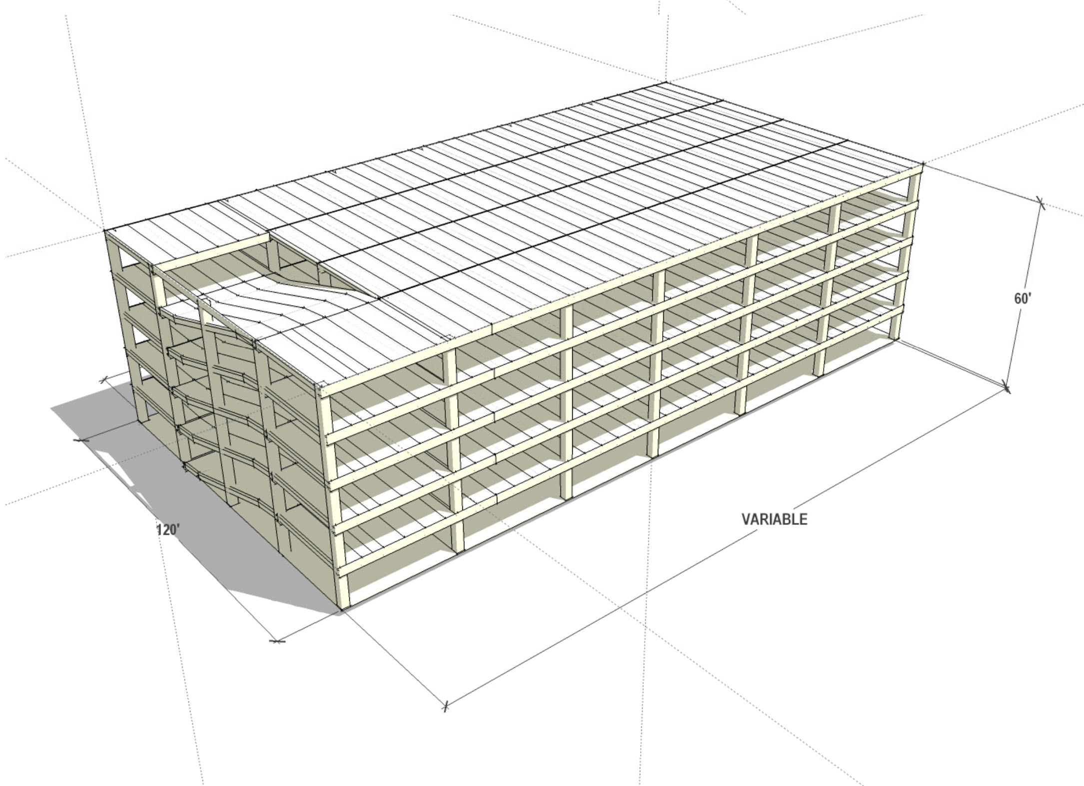
Camelback Helix (A & D)



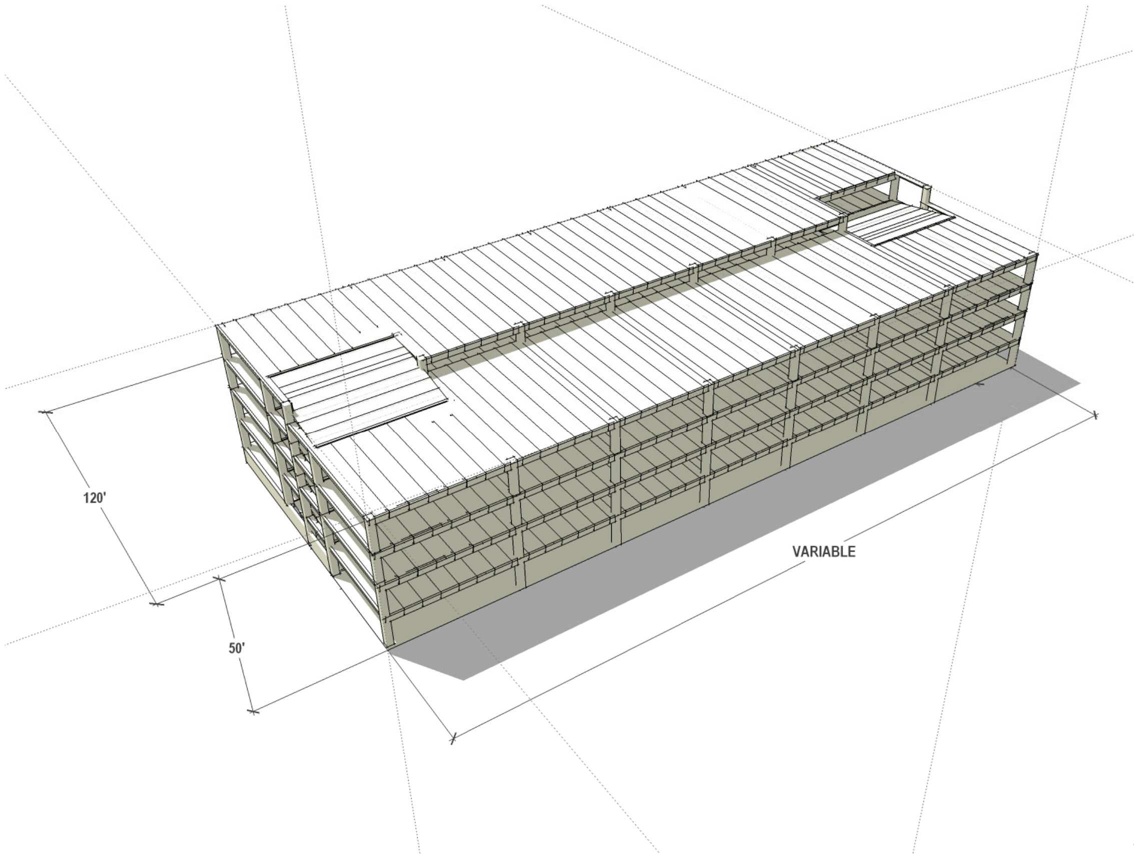


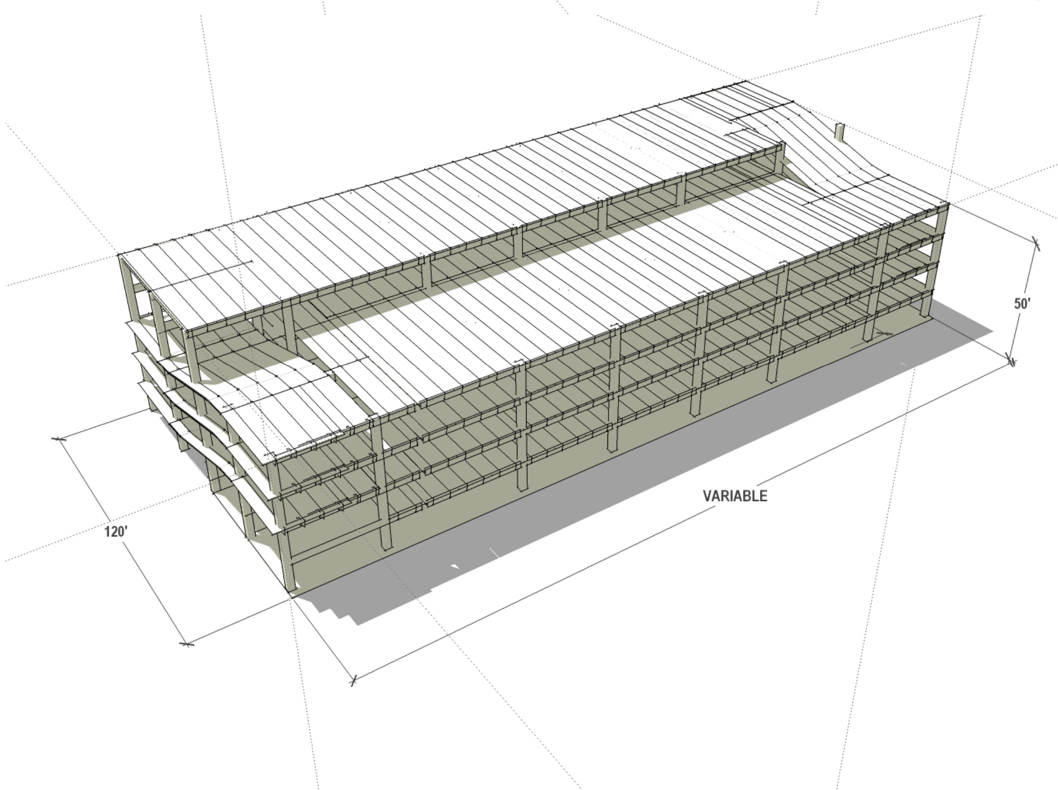
Three bay side-by-side (A & D)





Express Ramp 1
Express Ramp 2





Split Level One Way
Split Level Two Way

Finance

Financial planning for structured parking reconciles two realities: the real cost of parking and the role of taxation and financing mechanisms in its realization. The cost of parking includes both real and sudsidized cost and distinguishes between capital costs (construction and soft costs) and operational costs. Because revenue often falls short to pay these costs, taxation and financing mechanisms.must be employed.

Cost of Parking

To understand the true cost of parking today, one must trace the practice to the beginning of the Twentieth Century when parking was provided free on downtown city streets. As demand increased, both private and public entities began to provide off-street parking, and in many cases, charged a fee. As suburban malls and office complexes developed with free surface parking, those controlling downtown parking felt pressures to compete, and over time, parking was no longer “market priced.” While meters were added on street, pricing has never kept pace with inflation and some cities provide off-street parking that was free or subsidized well below the real cost. Presently, the total costs associated with providing and maintaining parking spaces is rarely passed on to users as the parking public has over time become accustomed to the subsidy. But as fuel prices increase and environmental concerns become mainstream, the case is growing that parking and automobile use should be treated more as a commodity and not an inherent right, and that doing so would make mass transit a more viable alternative. But when facing this new reality, many institutions and communities often face a “sticker shock” when they fully comprehend the costs associated with parking (construction, hard, soft, and operating), and the degree to which a projected revenue stream may not cover them due to a history of subsidization. Thus to develop structured parking today, which remains valuable, as the next section argues, a more precise amount must be decided on and new subsidizies, this time coming from sources – both public and private – consistent with downtown development and broader environmental mission, must be sought (Jakle and Scully 2004) (Schoup 2005).

Costs associated with constructing and maintaining parking can be broken down into either capital costs or operational costs. Capital costs are the cost to own, and include construction and financing, and operating costs include those required to keep the facility open and running.

Capital costs:

Construction Cost is the total amount paid to the contractor(s) for building the facility. Total Project Cost includes, in addition to construction cost, a variety of additional hard costs and soft costs. Hard costs cover land acquisition, demolition, off-site improvements and environmental remediation…..anything expended to physically improve the property. Soft costs include a variety of professional and design fees, reimbursable expenses, contingencies, and financing costs. Examples of fees and expenses include the cost of surveys, geotechnical testing, materials testing, specialty consultants (zoning, code, landscaping) legal, administrative, insurance, etc. Contingencies are amounts added to the budget, as a percentage of construction cost in the early design phases when other major elements (such as construction costs) are still estimates. These cover issues not addressed in design or to cover unforeseen site conditions or changes in design. Typically, until design is completed, the contingency is set at 15% of the construction cost budget. Another 10% may be added for financing and administrative costs, which are fees associated with obtaining loans to fund the difference between total project costs and owner's equity in the project. Table 11, 12, and 13 help illustrate the breadth and complexity of the entire project cost estimating component.

Thus it is possible to project that for an above grade structure where construction costs are $45 per sq. ft. and typical efficiency is 325 sq. ft. per space, total construction costs amount to just under $15,000 per space. As of July 2007, a basic garage in the New York metropolitan area cost $17,000 per space to build above grade, and, depending on number of levels and site geologic conditions, between 50% and 100% in excess of that to build below ground.

Operating costs:

Operating costs generally include labor (wages and benefits), management fees, security, utilities, insurance, supplies, routine maintenance, structural maintenance, snow removal, elevator/parking equipment maintenance, and other expenses. If the facility is a privately-owned structure, taxes (whether sales, property, or some other type) are also be included. If the facility is municipally-owned it would likely pay no property taxes. Table 14, displays Median Average Annual Operating Cost per space, by category and in total for 2006.

Finally, when project cost per space is known, and annual operating expenses can be estimated, it is simple enough to calculate the monthly revenue that would be necessary to pay for the space, and compare that with market rates to determine if there is a reasonable expectation that they can be charged. Table 15 displays such a matrix. Thus, if construction cost is in the range of $17,500 per space (a reasonable estimate in the current market, and reviewable in Table 13), and annual maintenance is estimated at approximately $600 (see Table 14), then the monthly revenue per space necessary to recover these costs would exceed $220. This amount is easily twice what commuters are willing to pay and makes abundantly clear that for structured parking to pay for itself, it must seek either supplementary users or some form of subsidy.

Financing/Taxation Mechanisms

In June 2006, The Urban Land Institute published a study titled "Parking Matters – Designing, Operating and Financing Structured Parking in Smart Growth Communities" (Morgan Ed. 2006) for which the principal investigator of this document was a contributor.

A summary of the financing and taxation mechanisms described are summarized here. "Parking Matters" groups these tools into three categories: Revenue Bond Financing, Tax Financing, and Qualitative/Parking Systems (Enhancements/Supplemental Financing). It also identifies Existing Zoning and Districting tools and tax credits, and makes recommendations for additional methods of financing of structured parking. Table 2 is a decision tree that maps the financing choices that must be made throughout the process.

Revenue Bond Financing:

A municipal bond is a bond issued by a state, city or other local government, or their agencies to raise funds. They are general obligations of the issuer or secured by specified revenues. Municipal bonds are either *guaranteed* (when the municipality or some public entity with taxing powers resolves to subsidize any payment shortfall in times when pledged or dedicated revenues ever fall short) or *stand alone* (when the only source of income pledged to pay debt service is the revenue of the project, or the revenues of the project plus other parking facilities in the system). A project qualifies as a *project test* if its annual projected net income is sufficient to cover the annual debt service on the bonds. A project is considered a *system test* if the annual projected net income of a project is insufficient to cover the annual debt service on the bonds, and additional revenue must be dedicated to pay debt service. In many cases, the additional revenue comes from other parking facilities in a public parking system such as surface lots or on-street parking meters. When project parking revenues or system parking revenues alone are insufficient to cover debt service and operating expenses, other sources of revenue can be pledged to fill the gap, and the project qualifies as a *hybrid test*.

"Other" revenue sources needed to fill the gap are: rent from grade level retail, air rights leases, ground leases, or payment in lieu of taxes (PILOT). A PILOT is a payment made to compensate a local government for some or all of the tax revenue that it loses because of the special nature of the ownership or use of a particular piece of real property.

Tax Financing:

A municipality may levy an additional assessment upon private property in proximity to a parking facility, for a period of up to 20 years in order to repay expenses associated with building a parking structure. Upon completion, all costs associated with the financing, public advertising, engineering, land acquisition and construction (hard & soft costs) of the local improvement must be detailed and certified by the municipality/parking authority to the local assessment officer, or to a general board of assessment if such a board has been created by the governing body. The assessment officer or board of assessment then determines the private properties positively affected by the public parking facility. The affected property owners are then given written notice by mail of public hearings to determine the assessment to be levied upon their private property for the advantage or increase in value which the respective real estate has received by reason of the parking structure. Private property owners may appeal these assessments if they feel they are being unfairly assessed.

Supplemental Financing:

Supplemental financing mechanisms include tools that are outside the realm of ordinary bond financing and other municipal-based tools of levying additional assessments or taking advantage of zoning and districting measures. They include a variety of creative options including enabling/receiving payments in lieu of parking, rental income subsidies, and the sale of development rights.

Payment in Lieu of Parking (PILOP):

The high cost of providing structured parking in urban environments often affects a project's feasibility. This results in developers requesting waivers from municipal parking requirements. Even allowing for shared parking and transit oriented development (TOD) parking credits, a project developer may still seek parking waivers. A municipality that adopts an ordinance that implements a program for a PILOP, or in-lieu fee, offers a developer the option to pay a fee for each waived parking space, in lieu of providing the number of parking spaces required by local land use ordinance. The municipality or parking authority then uses the PILOP fee to construct a parking structure available to the user or occupants of the development project, as well as to the general parking public.

Rental Income:

Rental income from office and/or retail components added to public parking garages may also subsidize a parking structure's operational expenses or debt service payments. Commercial or office components that are integrated in parking structures on grade and at the second story, to enhance streetscape and break up the monolithic presence of a garage, are often desirable real estate and command high market rental rates.

Sale of Development Rights:

Many cities and parking authorities own downtown surface parking lots, where real estate is always valuable. These parcels, although an important public parking resource, are not necessarily fulfilling their highest and best use, both as a parking resources and in terms of assisting a downtown's revitalization needs. Municipalities and parking authorities can sell and transfer their development rights and use the funds received to build structured parking.

Existing Zoning and Districting Tools:

A number of legal mechanisms exist by which municipalities and developers can enhance the attractiveness of a project's finances, either by enabling additional assessments, granting tax exemptions or waivers, or claiming tax credits. These tools include the establishment of

Urban Enterprise Zones, Special Improvement Districts, Redevelopment Area Districts with associated Bonding, and New Market Tax Credits.

Urban Enterprise Zones:

A significant number of cities in New Jersey have been designated as Urban Enterprise Zones (UEZ). At the present time, 37 cities, including Asbury Park, Camden, Elizabeth, Newark, New Brunswick, Perth Amboy and Trenton have been designated.. As an UEZ, the designated city is permitted to charge consumers 50% of the current sales tax. The 50% sales tax is collected by the merchant and forwarded to New Jersey's Treasury Department. The Department then makes funds available to the originating UEZ city typically for streetscape improvements such as sidewalks, street furniture, street lights and curbing, including all associated soft costs such as architectural and engineering services. While it is unlikely that UEZ funds would be approved to subsidize the cost of operating or debt service for a parking facility, administrators have approved funds to pay for the cost of land acquisition and project construction.

Special Improvement Districts:

Special Improvement Districts (SIDs) are hybrid, quasi-public/quasi-private entities, created through a municipal ordinance, and are geographically distinct. Typically, a municipality designates a non-profit private entity as the management corporation for the SID, which establishes and implements its policies and programs. Special Improvement assessments are imposed on all properties included within the District, and these can be used to fund all or portions of structured parking facilities or credit enhance their financing.

Redevelopment Area District/Redevelopment Area Bonds:

The Redevelopment Area Bond Financing Law (RAB) and the Revenue Allocation District Law (RAD) are two new tools created by the New JerseyLegislature in 2002 for redevelopment and revitalization. New Jersey has recently witnessed the measurable impact that well-located and well-served transit stations with sufficient parking can have on real estate values within proximity of the station. This increase in residential value could be the basis of a tax-increment financing (RAD) structure to be utilized for local and regional improvements to increase utilization of the stations, including the financing of parking structures. The Revenue Allocation District Financing Act allows a municipality to pledge the increase in taxes resulting from a redevelopment project to the repayment of bonds issued to finance any or all of portions of the project. The Redevelopment Area Bond Financing Law also allows municipalities to grant tax exemptions or abatements to developers and to pledge the payments in lieu of taxes (PILOTs) to the repayment of bonds. The RAB also authorizes special assessment as a protection against bankruptcy to insure the PILOTs.

New Market Tax Credits:

The New Market Tax Credits (NMTC) Program was originally instituted as part of a federal program titled the "Community Renewal Tax Relief Act of 2000." The NMTC Program creates a tax credit for equity investments made in Community Development Entities (CDEs). The NMTC enables investors to claim tax credits equal to 39% of individual equity investments over a seven (7)-year period: 5% in each of the first three (3) years and 6% in each of the final four (4) years. In New Jersey, several CDEs are active in the NMTC program. One of the most significant allocations was awarded to the New Jersey Economic Development Authority, through its entity, NJCDE.

Recommendations to Expand Financing Options:

The Parking Matters report recommends five additional ideas that do yet exist but with political will could become effective tools to enable financing of structured parking. These include:

- increasing the gasoline tax to generate a significant long-term funding source for parking infrastructure, as recommended by the Regional Planning Association.
- utilize Casino Reinvestment Development Authority funds as a second source behind a primary lender.
- commit funds from New Jersey's parking tax statute (*N.J.S.A.* 40:48C-6) to build parking improvements within a municipality, rather than for property tax relief.
- modify the existing statutory and regulatory structures such as RSIS and support educational processes to implement shared parking concepts in the legislative and real world contexts.
- levy an assessment of fifty cents per month per space on each of the five million surface parking spaces in commercial, retail and office uses in Planning Areas 3, 4 and 5. This would result in a funding pool of $30 million annually.

Summary

- Determine that the need for Structured Parking is unequivocal
- Gain the community's support to enable a successful solution
    - enlist in visioning, but prohibit yes/no referendums
- Accurately project demand and size the facility properly
- Locate the facility appropriately
    - align with/adjust community wide land use considerations
    - choose appropriate proximity to transit
- Identify shared parking opportunities and implement programs to maximize utilization
- Identify desirable mixed use opportunities
    - take advantage of shared parking synergies
    - leverage finances
- Solve circulation issues
    - optimize vehicular and pedestrian access
    - project traffic impacts and adjust patterns if necessary
- Select the appropriate form and levels of service
- Understand the real costs of parking and potential subsidy requirements
- Understand and pursue existing and potential financing mechanisms

DESIGN

Once needs and possibilities are determined in the planning process, a structured parking project must be designed to satisfy those need within the parameters chosen. Those design parameters include function, cost, impact to surroundings and the overall aesthetic quality associated with using it. For the purposes of this study, design has three integrated foci. The first is **engineering,** the objective concerns of how it is produced and used. Second is **urbanism** – how a project integrates and harmonizes with its immediate and broader environment. This section situates the parking structure in the broader discourse surrounding **Smart Growth** planning, focusing on the four qualities of a transit village: **density, diversity, design and destination**. Third is **architecture** – the orchestration of how all the constituent parts come together to achieve the highest possible quality of experience in the whole. This section begins with the placement in a timeline of architectural development in the 20th century and continues with an inventory of the constituent parts of a parking structure include **interiors, portals, towers and facades.** It concludes with a discussion of the overall **integration** of these and other parts.

Engineering

Engineering constitutes the determination of what the project is physically, how it is built and how it operates. This begins with all aspects of its general **construction** including **foundations** and **systems;** how it is built and its costs determined; **construction management** and **cost estimating;** and finally, what are the transformative possibilities in the areas of **information technology** and **automated mechanical parking structure** improvements.

Construction

Parking structures come in three basic types: open, enclosed and underground. An open parking structure must have uniformly distributed openings on two or more sides. The area of such openings in exterior walls on a level must be at least 20 percent of the total perimeter wall area of each level. The aggregate length of the openings considered to be providing natural ventilation shall constitute a minimum of 40 percent of the perimeter of the level. Interior walls shall be at least 20 percent open with uniformly distributed openings. Open structures, by code, do not require mechanical ventilation or sprinklers. Enclosed structures (above and below ground) require ventilation and fire suppression systems, which add to their cost.

Open parking structures are in effect an extension of the paved roadway and are subjected to rain, ice, snow, sun, temperature extremes and freeze-thaw cycles. De-icing salt placed directly on entrance and exit ramps, or brought in by vehicles, accelerates the corrosion of reinforcing steel in structural concrete members. Attention must be paid to reducing salt intrusion into the concrete by providing good drainage, crack control, low permeability concrete, and deck overlaps.

Parking structures are generally constructed using the following systems:

- Cast in place concrete consists of heavily reinforced concrete slabs (with or without beams) rigidly framed to concrete columns, all poured at the building site. The heavy monolithic construction performs well under vehicle induced vibrations. This type of system is only possible with short span construction, typically on a 30' by 30' module. Because this arrangement requires locating columns in parking areas, efficiencies are lower and the cost per space higher. For this reason, long span construction (spans greater than 60') is strongly preferred for most parking structures (except where they are under ground or under a primary use such as office or residential).

- Structural steel is a construction type in which girders, beams, and columns of structural steel support pre-cast or cast-in-place, post-tensioned, concrete slabs. The structural steel members must be protected by corrosion resistant coatings. Lighter foundation loads and speed of on-site assembly are positive features of this system, while maintenance of paint on steel members is an ongoing cost issue. Moreover, if the building code requires fire rated-protection of steel, this system is not likely to be cost effective as compared to pre-cast or post-tensioned systems.

- Post tensioned cast in place concrete is a technique where concrete 'one way' slabs (direction of reinforcing: as opposed to two-way) and beams frame into regularly reinforced concrete columns. Post tensioning refers to the procedure of inducing stress into the concrete after it has cured on site, so that it may counter deflection loads more effectively. Post tensioned members are generally smaller and lighter for a given span and are less subject to cracking.

- Pre cast concrete uses concrete members that are pre-fabricated off site and delivered and erected on site. Members include double tees, hollow core plank, spandrel beams, walls, columns, stair units, etc. Speed of assembly, which leads to lower labor costs, is pre cast concrete's principal advantage. And because of inherent efficiencies, factory fabrication reduces unit costs. However, casting and assembly tolerances and connections between members, which often need to be field welded, require constant vigilance due to corrosion. notwithstanding this drawback and periodic demand spikes that make another system more appealing, pre cast concrete is by far the preferred structural for downtown structured parking.

Foundations

To select the desired foundation system, subsurface site conditions must be investigated via soil borings and rock cores to identify the feasible bearing strata for the structural loads. Where satisfactory bearing conditions are located close to the surface, shallow foundations consisting of spread footings, wall footings and mat foundations are most economical. For marginal bearing conditions, improvement of the bearing strata can be considered using dynamic compaction, preloading of compressible soils, and grout injection.

Where suitable bearing strata are located at some depth below the surface, deep foundation techniques such as drilled shafts, stone columns, displacement piles, friction piles, end bearing piles, and caissons can be used. The need for a deep foundation system to support a parking structure can substantially increase the complexity, time required, and cost of a project (Chrest 2001).

Systems: Mechanical, Lighting

Most above ground parking structures are of open design with at least 20 percent openings in the exterior walls on each level and thus require no mechanical ventilation. For closed and underground parking structures, proper ventilation must be provided to exhaust carbon monoxide and draw in fresh air. Maintenance and servicing of the mechanical ventilation systems can be an issue.

Sprinkler system fire protection is usually not required by code in open design parking structures, whereas underground facilities and closed structures often do require sprinkler fire protection.

Drainage piping is needed to allow for removal of rain, snow and ice that can enter open structures directly, or come in on vehicles in closed structures. Underground parking structures require additional drainage sumps and pumping to remove seeping surface and ground water.

Lighting may be one of the most critical elements in parking structure design, arguably more so than in other building types. Lighting is required for visibility of fixed objects, vehicles, and pedestrians. Because vehicles and pedestrians frequently use the same circulation aisles, drivers must be more alert to potential hazards, with less time to react, than is necessary for pedestrians. To achieve this, good illimination is essential. Additionally, and as noted previously, parking facilities are at a somewhat higher risk of violent crime than most other land uses, and lighting is not only the most critical element in reducing crime, it is also a major contributor to the user's perception of safety and security.

The significant issues for lighting design ultimately include selection of lamps, or light source, selection of fixtures, and placement of fixtures. The Illuminating Engineering Society of North America (IESNA) is the technical authority for the illumination of indoor and outdoor environments. Amongst their various guidelines is the current recommended practice *RP-20 Lighting for Parking Facilities* (1998). The updated practice can also be found in the ninth editions of the *IESNA Lighting Handbook* (2000).

The guidelines establish minimums and uniformity ratios, quoted in both lux and footcandles (fc), for a variety of specific elements, across paired scenarios. The specific elements include horizontal illuminance, vertical illuminance, and specific areas such as ramps, entrance areas, and stairways. The paired scenarios include basic requirements vs. an enhanced security requirement, and day vs. night.

While these guidelines establish minimums that are required to be met, many owners and developers today are asking for higher lighting levels than the "minimum." These are for applications with a higher emphasis on "user-friendliness", such as airports or retail, but also those who may be at a higher risk for security problems. In response to these desires, a Level of Service (LOS) approach, precisely similar to that identified in the earlier section on selection of type, has been adopted. In this ranking, the IESNA minimums (1 fc, 10 lux for minimum illuminance, 4 fc, 40 lux for average illuminance). is LOS D. Levels of illumination rise in a linear gradient to the highest, LOS A (4 fc, 40 lux minimum, 10 fc, 100 lux average).

Several different lamp types are commonly used in parking facilities, and can be grouped into two broad categories: fluorescent and high intensity discharge (HID). All of these types consist of a sealed arc tube with two electrodes. The tube is filled with a gas that is ionized by the passage of an electric arc through it. HID lamps, commonly used in parking facilities, include mercury vapor (MV), metal halide (MH), and high-pressure sodium (HPS). Low-pressure sodium (LPS) lamps, commonly used in roadway lighting, are inappropriate for parking environments because of poor color rendition.

The key issues in lamp selection are: energy efficiency, depreciation of light output with age, lamp life, color rendering, and life cycle costs. Each lamp type performs differently across each of these criteria, and the pro's and con's must be balanced. One nearly universal application of note is that of fluorescent lighting for emergency uses. Fluorescent lighting has very good color rendition, and start up within seconds – as opposed to minutes with HID lights – and are therefore preferred for emergency applications.

Construction Management

Traditionally, field construction work on a parking structure does not start until the architect/engineer has completed and finalized the design and the contract has been awarded. However, it is possible to reduce the total project time by fast tracking the project - starting the construction before the total design is completed. As the progressive design phases of the project are finalized, these parts of the project are put under contract. Fast tracking can significantly reduce the total time required for completion, but does require more project coordination, thus potentially adding cost. The design-build form of contract lends itself well to fast tracking a parking structure project and can produce savings of cost and time. Where a parking structure owner lacks expertise in procuring design and construction services, a professional construction manager can be retained to supervise the entire project from inception to completion.

Cost Estimating

Construction costs for structured parking vary due to: type of construction system; type of foundation required; efficiency of parking design; architectural treatments and amenities; labor costs; and market factors. These variables result in above ground structured parking costs of from $15,000 to $20,000 per parking space. Underground parking costs additionally are affected by geologic conditions at the site and by the number of levels of parking below grade. As stated previously, underground parking space costs can be expected to be 50% greater than above ground structured parking (for one level), and up to double for multiple levels.

For the purpose of providing a method of cost comparison between the various structured parking alternatives developed in the design testing, a standard set of unit costs for the various components of a mixed use project was employed. It is shown in Table 3.

Information Technology

Various information technology applications have been developed for parking structures to increase efficiency. These focus primarily on sensing and communications systems. The efficiency of these systems is greater for larger systems with large facilities, and may have limited value to the scale of facilities this report focuses on. They are described nonetheless, and can be applied in certain cases.

Technologies exist to sense vehicles to varying degrees. The simplest is the ability to calculate how many vehicles are in a structure at a given time. This is done by simply counting the number of vehicles entering, subtracting how many have exited, and comparing the figure to the garages known capacity. These involve straightforward counting devices at entry and exit gates. The goal is to warn drivers that a facility is full, primarily to alleviate frustration. To circulate through an entire structure without finding a space will not only inhibit someone returning, it will likely cause a commuter to miss a train. The warning can take many forms. While the simplest is to hang out the full sign, Variable Message Signs (VMS) are increasingly being used at a facility's portal and at remote locations to intercept drivers before they are close and redirect them to another facility. In the San Francisco metro area, BART is using VMS to identify how many spaces are available at different stations, allowing drivers to change plans if facilities are nearing capacity. In a downtown transit oriented location, VMS can redirect drivers to alternative locations in a timely manner so as to not disrupt commutes.

A higher degree of sensing involves locating available spaces in a given facility. This can sense by level or by sensors at each stall. Parking structures at Houston International Airport use wires embedded in the floor to sense when cars enter and exit each level and send that information to a central computer. Information boards at the entry inform drivers upon entry and red and green lights at each level give more specific information. A more complex system at Baltimore Washington International (BWI) Airport uses ultrasonic sensors mounted over each parking space to monitor occupancy. Illuminated signs at the end of each row indicate the number of spaces available. Smart Park, the vendor for the BWI facility, advertises that the system increases the effective capacity, usually hovering around 85%, enough that the additional revenue pays for the system in a relatively short time.

While this high a degree of sensing might yield dramatic efficiency increases, systems must be very large. In the simple helix that most downtown communities will likely build, the ability to sense whether a facility is full or not should be sufficient; a driver will simply circulate until they find a space. Critical to this assurance is policing vehicles that occupy more than one space. Only when a facility has points in its circulation system where drivers can make a choice, does the higher degree of sensing benefit, as when there are multiple levels or where speed ramps exist.

The communication technologies that inform drivers where to park go beyond signs such as VMS. Systems are available, such as at the BART system, where drivers can make advance reservations to ensure a space. (Shaheen et al 2004) In real time, radio broadcast and increasingly various wireless devices, principally cell phones, can alert drivers of congestion at a specific facility. Recorded messages can be sent at a pre-arranged time to warn drivers if problems arise. Drivers can call for a pre-recorded message or log onto a website to determine conditions. Certain European systems coordinate this information with in-vehicle navigation systems Watterson 2001). Again, these are more beneficial to large systems and might bear little applicability to the scale of downtown parking that this report studies.

The most effective communication systems for downtown parking enhances payment practices. The ability to pay automatically while passing through a portal using Radio Frequency Identification (RFID) transponders such as EZ Pass has obvious advantages and has already been discussed. The ability to use cell phones to reserve a space as discussed above or to use cell phones to pay for parking, a practice known as m- commerce, is becoming mainstream in many locations. In Vienna, drivers pre-register their cell phones, license numbers and credit cards. When they park, they send a text message identifying their location and for how long they wish to park, to which they receive a confirming text message. Ten minutes before their time is up, they receive a reminder to return to their vehicle or pay again. Applications of a similar technology in Melbourne, Australia yielded many complaints (Smith and Roth 2003). While these real-time systems might not benefit commuters, they benefit retail parkers. Although undocumented, these automated payment systems make less glaring the true cost of parking. How many actually review their EZ Pass statements to review how much has been spent on parking?

Automated Mechanical Parking Structures

There has been recent renewed interest in automated mechanical parking garages (AMPG) largely brought about by a well-organized and financed marketing campaign. Mechanical garages in the United States can be traced back to the 1930's, and quite a few were developed in Chicago, New York, and Boston during this period (NPA 2003). However, many were plagued by mechanical problems, breakdowns, issues with oil drippings and vehicle processing times. As a result, the structures began to lose favor. But, the biggest blow to the industry occurred when the Wall Street community refused to underwrite financing of the structures due to the ongoing problems, a refusal which continues to this day.

In recent years, AMPG have been developed in Europe and Japan that avoid the above problems, and a few facilities have been built in the US - one in Washington, D.C. and one in Hoboken. The D.C. garage is a private facility that holds 74 cars and serves an upscale apartment building. Its retrieval rate is slow and incapable of serving anything but a modest sized residential facility. The Hoboken garage is a 324 space public facility and uses a different technology with a faster retrieval rate. It was built and is currently operated by a private company under contract to the Hoboken Parking Utility. While it enjoyed early success and favorable press once it opened, the project was completed three years behind schedule and over budget. Over time, the Hoboken garage has been plagued with many of the problems of earlier facilities; frequent breakdowns and customer satisfaction issues relating to vehicle retrieval times. In two cases, automobile were dropped. The unfortunate finger pointing, lawsuits, and accusations of corruption by all parties involved in Hoboken has tarnished AMPG's initial promise of revival. And although two Design Testing projects included in Appendix C employ a robotic solution, this report does not recommend an AMPG application until an American vendor establishes a proven track record of success.

Urbanism

Urbanism governs the design of downtown environments; how well a parking structure integrates there is critical to a downtown's success. Urbanism, often referred to as urban design or traditionally, town planning, is a discipline that overlaps planning and architecture. Some of what has already been recommended in the planning section of this report falls within the domain of urbanism as will parts described in the following section on architecture. That urbanism applies only to cities is a misnomer; it applies to the urban unit, whether it be Times Square, the suburban areas that this study focuses on, or the rural village.

Arguably, a community cannot grow beyond a certain scale without structured parking. As a result, the building of a parking garage signifies a critical point in its evolution, as has already been stated. To many in a community, it means that they are decidedly becoming urban, a designation not entirely welcome among suburban residents, many of whom fled urban areas a generation ago for the refuge of the suburban village. To watch that beloved village become the place they escaped can indeed produce anxiety. To them, even the word "urban" connotes crowding, crime and bad schools. Yet to others, the positive aspects – amenity and choice – cancel out the negative. For this cohort, whose numbers seem to be on the rise, the same urban environment evokes culture, parks, museums, theaters, universities and shopping. Thus, urbanism as a discipline can bee seen to have negative or positive values, depending on where it is applied.

<u>Smart Growth</u>

Urbanism today is a major component in Smart Growth planning strategies that seek to concentrate residential and commercial uses in already developed areas, including downtowns, in order to combat sprawl. Smart Growth practitioners plan communities that are compact, transit-oriented, walkable, bicycle-friendly, and include mixed-use development with a range of housing choices. Smart Growth planning seeks to be comprehensive and equitable, focusing on long-range, regional considerations of sustainability instead of short-term gain.

In detail, Smart Growth strategies focus on:

- defining a small area in which intense development is permitted, and a larger area outside it where development is strictly limited
- transit-oriented development
- historic preservation
- inclusion of affordable housing
- mixed-use development
- walkable and bicycle-friendly design
- preserving open space and critical habitat, reusing land, and protecting water supplies and air quality

- inclusion of parks and recreation areas
- restrictions or limitations on suburban design forms (e.g. detached houses on individual lots, strip malls and surface parking lots)
- transparent, predictable, fair, and cost-effective rules for development (Porter et al 2002)

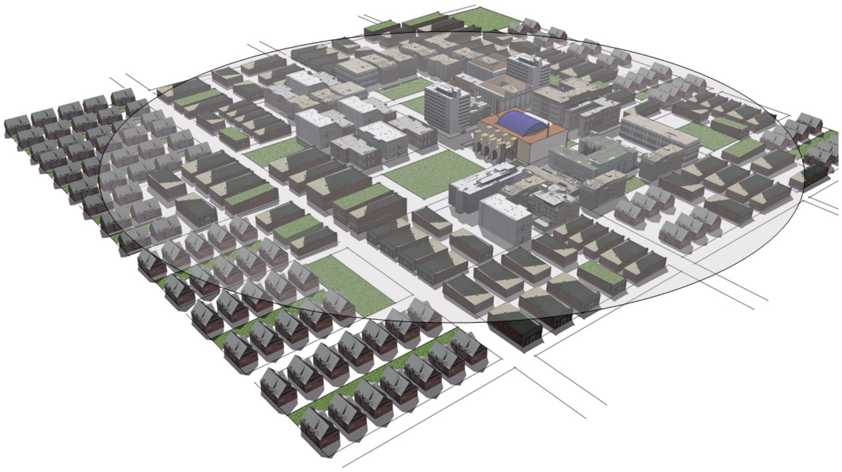
Because Smart Growth concepts are not universally agreed upon, implementation is measured by degrees – how many elements of smart growth a downtown exhibits. Sometimes, smart growth elements contradict one another as they do with structured parking, where critics might argue that the provision of parking encourages driving over transit. These critics forget that Smart Growth maximizes choice and parking can be simply a choice, especially when priced accordingly.

Structured parking actually satisfies a number of Smart Growth goals. First, except in US environments with well developed transit cultures such as New York City, structured parking is essential to the densification required to foster a vital downtown. It is a requirement to allow density to exceed the 20 DUA level required for dense urban living. Second, structured parking in downtowns reduces congestion; shoppers will know to go to the parking structure directly, thereby reducing traffic associated with drivers cruising to find a parking space. Third, structured parking can be a generator of density itself, like a transit station. Finally, structured parking reduces areas of impervious pavement in a downtown, which has positive environmental impacts associated with lessening the urban heat island effect.

The paradigm for Smart Growth downtowns is Transit Oriented Development (TOD) or the Transit Village. In this report, these terms are used interchangeably, but while TOD describes development focused on transit at any scale, it is difficult to imagine Times Square as a transit village! Given that this study focuses on medium-scaled downtowns, however, this ambiguity will never apply. Transit Villages typically surround a train station with relatively high-density development that graduates to progressively lower-densities spreading outward from the center. Planners typically categorize a TOD as a minimum ¼ to a maximum ½-mile radius from the transit stop. A more precise way to gauge transit's influence in a TOD is to measure the distance one takes to walk five or ten minutes. By this method, a busy street that might take a minute to cross would severely constrain the

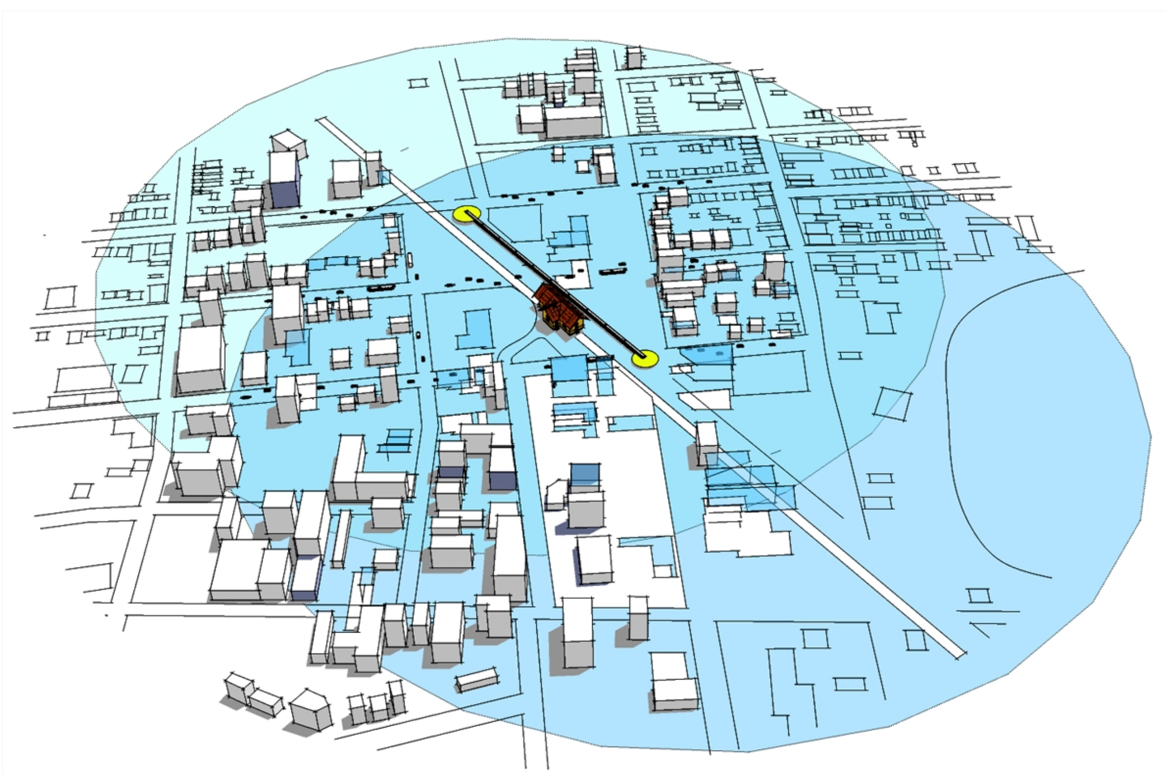
TOD radius

catchment area of a Transit Village.



TOD radius

Conversely, when passengers disembark from either end of a ten-car train almost a ¼-mile long, the radius becomes an oval. When measured in minutes, the quality of a walk also becomes important. Walking along a busy highway or in a forlorn neighborhood might make a trip seem far longer than it is, and thus less acceptable. In contrast, walking along a pleasant street, one might go twice as far and desire to go even further (Bernick and Cervero 1996).



TOD radius as oval – due to lengthy train

Structured parking can generate its own radii based on the distance from parking to a retail destination or housing, with measurements that are consistent with those of Transit Villages. Suburban mall planners typically allow no more than 600 feet, about a three minutes walk, from the furthest reaches of a parking lot to a mall's entrance, but take great care to disguise the distance one must walk within the mall, and even seek to expand it. This is because the experience within the mall is not perceived as a burden, but as a pleasant shopping experience. The pedestrian experience around a parking structure of a successful TOD can be similar, allowing the parking structure to serve a downtown shopping area. In dense residential communities such as Hoboken, many find it acceptable to park in structured facilities that are up to a half mile away from their homes. What this comparison suggests is that structured parking in downtown communities can, if properly located, become its own generator of density.

The attributes of Transit Oriented Development are the 4 D's: **density, diversity, design and destination**. Each of these attributes relates to how structured parking can be effectively developed in a Transit Village (Calthorpe 1993).

Density

Density refers to a consolidation of residential with commercial, office, institutional, or other activities. Ideally, they satisfy needs of commuters arriving at or leaving the station. Institutions such as universities and office development can also be major anchors of TOD as evidenced by New Brunswick.

The measure of residential density is dwelling units per acre (DUA), which is a net figure excluding streets and public spaces. A *dwelling unit* represents a discrete individual address or household, not simply what appear to be one family homes. Field measuring of dwelling units often involves counting mailboxes. Single family detached units can be as high as 8 DUA while anything higher implies some form of multiple dwelling; two unit or three unit housing units. TOD minimally requires 12 DUA. Downtown development in New Jersey can range from 12 up to 50 DUA, all with housing based on the walk-up type without elevators. Elevator housing can exceed 50 DUA in environments such as Hoboken and Jersey City. Developer Joel Schwartz of Landmark Development argues that when densities exceed 20 DUA in downtown New Jersey developments, structured parking becomes the only way to satisfy parking needs.[4]

[4] Schwartz, Joel, Landmark Development. Seminar Presentation, New Jersey Institute of Technology, Newark, NJ, November 8, 2004.

16-18 DUA

25-50 DUA

50+ DUA

One of the hurdles to communities accepting densities that this study identifies is the fear that downtown units would unduly burden already overstressed school systems. Recent research by David Listokin conclusively shows that because these units tend to be smaller, targeting either young professionals without children, or older "empty nesters," they do not add significant numbers to the school age population. The data does support, however, that when these units are affordable, they add to the school age population.

The commercial enterprises of TOD are generally characterized as downtown stores, usually individually owned business that cater to a relatively small catchment area of approximately 5000 residents. This is consistent with the notion of an "urban village" developed by Herbert Gans in his classic text of the same name. TOD businesses are often located within the train station itself as in South Orange and in Princeton Junction. The recently constructed train station in Rahway follows this example. TOD shops are often organized according to the kinds of errands run when walking to, or from, a train station. These might include purchasing a newspaper or coffee, dropping off dry cleaning, filling a prescription, renting a video, or picking up a take-out pizza. It is rare that one can find national chains in TOD (perhaps with the exception of rival drug stores such as CVS and Rite-Aid in New Jersey) although there is some evidence that some national chains are moving into TOD such as the presence of Williams of Sonoma, and The Gap within 1/8 mile of the Upper Montclair train station. Some downtowns even have smaller department stores, such as Lord & Taylor in Westfield.

Williams of Sonoma at Upper Montclair station

Institutions such as universities and office development can also be major anchors of TOD. Although the overwhelming number of trips in New Jersey are to the labor markets of Manhattan, there is some indication that downtown locations are becoming destinations in themselves. The best example of this in New Jersey is New Brunswick, given the presence of Rutgers University, Robert Wood Johnson Medical Center, and the Middlesex County government offices. It should be noted that each of these provides mixed use structured parking that works in concert with commuters arriving by rail.

<u>Diversity</u>

Diversity in TOD refers primarily to land use and is meant to redress the pattern in most post-war development in the US of organizing land use in sectors, which some refer to as Euclidean zoning. This disaggregation typically forces automobile trips between home, work, commerce, school, etc, and is incompatible with TOD. A TOD must have a diversity of land uses all within walking distance in order to thrive.

Diversity also implies heterogeneity. Used as an adjective, diverse in a Smart Growth context serves many nouns: land uses, retail, office and housing types, income, age and racial groups and mobility options, to name a few. The pertinence of diversity with relation to parking for this study is that structured parking for commuters, as previously argued, cannot be self-liquidating given the current amounts commuters are willing to pay (approx $100/month). If a revenue stream can be identified for nights and weekends, or if some portion of structured parking can be designated for shorter term use (which produces a higher rate of revenue), this can provide the necessary financial complement. Thus, shared parking as a strategy can be seen as part of a larger Smart Growth strategy, and has other benefits besides limiting the need for unnecessary parking in downtowns.

Retail is a common additional program to integrate with a parking structure at street level. Besides the financial benefits of additional revenue streams, well executed retail enlivens the streetscape and adds vitality to a TOD. But the inclusion of retail has an impact on the structure itself due to floor-to-floor accommodations. Retail establishments typically require ten (10) feet of clear space to the ceiling inside, two feet higher than the typical parking structure clearance. And if the retail is a restaurant, requirements for ventilation equipment adds several additional feet of clearance. This additional height requirement will have an impact on either ramp length, or ramp angle, and thus level of service.

Design

Design is argued primarily in aesthetic terms. While density and diversity can be measured empirically, the test of design is often qualitative. The high quality of design experienced while walking in a transit village can indeed make a trip seem far shorter than it is. Design in TOD often refers to the whole space of the street as if the street were a room in a building. Using this metaphor the street and sidewalk are the floor, the storefront and building elevations represent the walls, and streetlamps and perhaps a canopy of trees correspond to the ceiling. The urban design term for these is "streetscape" and refers to the comprehensive understanding of elements that define these "rooms". Elements that are located within these rooms, such as benches, trash cans, newspaper kiosks, and even parking meters, can be street furniture. Each of these elements should correspond in a harmonious way, in the same way that they do in an individual's home. Following this strategy, different streets should also appear as harmonious to one another. In this way, the house can become the governing metaphor for the entire TOD.

street furniture

Because aesthetic judgments are by definition so subjective, this is the area of strongest disagreement amongst planners, urban designers, and architects, who otherwise might agree on measures of density and diversity. The planning and design movement known as New Urbanism, and organized under the auspices of the Congress of New Urbanism (CNU) are adherents of Smart Growth planning, but suggest streetscapes that strongly evoke historical precedents. They recommend a style of architectural design practiced a century ago in America, citing the fact that these communities were designed around transit and pedestrian activity predating the automobile. The CNU is disparaging of modern design as lacking in the character necessary for TOD. The CNU also typically argue that modern architecture is out of touch with popular American tastes where people expect traditional design, especially in residential architecture. The widely published prototype of CNU development is Seaside, FL. At Seaside, the resale of traditional homes has far outpaced those designed in a modern idiom (Duany et al 2000). Critics of the CNU cite that, to date, most CNU development has not been in TOD, but in greenfield locations where the predominant transportation mode is the private automobile. thereby making them suburban and not Smart Growth development. By specifying in great detail how homes can be decorated or altered, the critics of the CNU counter that it is they (CNU) who are out of step with democratic American values (Krieger 1998). Most communities in New Jersey adhere to CNU values and are surprised when informed that a lively debate, primarily in the architectural community, is ensuing. Since there is general agreement on the more fundamental issues regarding density and diversity one can argue that these concerns are largely a matter of taste, and thereby cosmetic. Nonetheless, sensitivity is recommended.

Destination

Destination refers to travel options. TOD must first and foremost be walkable if not bikeable. It need not be served by rail transit if good bus connectivity prevails. In this kind of environment, structured parking serves as a destination where visitors park once and walk to potentially multiple venues. Downtown Princeton New Jersey is an excellent example of a highly functional TOD that is not immediately adjacent to rail transit.

Downtown Princeton consists of mostly low-rise development and sees itself as a village, not as a city. This belies the fact that, in terms of some of the functions of the University, and those of the corporate headquarters that lie hidden in the nearby woods, it would seem in some respects to be highly urbanized.

In fact, Princeton shares many attributes of transit oriented communities that could most benefit from this study. It is walk-able and relatively dense, with a mixed use of activities and a strong sense of place. Practically all of its parking is provided in shared facilities whether they are owned privately or by the municipality. There are very few reserved parking spaces in downtown Princeton. Ironically, what is missing is proximity to transit although there is considerable bus service and the train station is across campus from downtown – arguably too far to walk by most standards. In this regard the parking structure serves as the center of the community in the same way that a train station does for a transit village.

Three additional TOD's from around the country are worth noting because of the role played by structured parking in their execution. They are Mockingbird Station in Dallas,TX Lindbergh City Center in Atlanta, GA and Downtown Silver Spring near Washington, DC.

Mockingbird Station is a 10-acre mixed-use urban village located on a site adjacent to a Dallas Area Rapid Transit (DART) light rail station. The station is four miles, and an eight minute train ride, north of Dallas's Central Business District. Located at the intersection of Mockingbird Lane, a major east-west arterial, and the North Central Expressway. Mockingbird Station is also a major bus transfer center. The project is in the vicinity of Southern Methodist University, and a shuttle service links the campus to Mockingbird Station.

The project consists of 211 loft residences, 140,000 square feet of office space, and 180,000 square feet for retail, theaters, and restaurants. Developed by UC Urban, Mockingbird Station is almost entirely privately financed – a rarity for transit oriented development. The project incorporates the redevelopment of an abandoned Western Electric assembly plant with several new structures. It has been reported that Mockingbird Station has the highest density population within three miles of any mass transit station in Texas. Because of the previously deteriorating nature of the area, combined with the higher elevation industrial building, parking structures blended easily into the surrounding project. On the other hand, the city, still unsure about the potential impact of the transit, applied conventional parking requirements, with no reduction for being near transit. The project includes 1,418 parking spaces, which the developer feels is excessive.

Lindbergh City Center is a 51-acre mixed-use urban village in located at a Metropolitan Atlanta Rapid Transit Authority (MARTA) rail station in Atlanta. The Lindbergh station is located along Piedmont Avenue between the growing districts of Buckhead and Midtown in Atlanta, and has strong access to both Atlanta's CBD and Perimeter Center. At the time of the RFP, Lindbergh Station was MARTA's second busiest rail station and a major bus transfer center.

Oriented around new pedestrian-oriented Main Street, Lindbergh City Center will eventually comprise 2.7 million square feet of office space, 225,000 square feet of retail space, more than 700 residential units, 190 hotel rooms, and parking structures. MARTA issued an RFP for high density development at the site, initiating a public/private partnership between the city and Carter Associates, an Atlanta-based real estate development company. The focus of the project is a new pedestrian oriented main street that bridges the transit platform. The project expanded significantly in 2006 with the addition of new restaurants, retailers and a 352-unit mid-rise condominium complex.

The need to accommodate parking and a major bus transfer interface added considerable complexity to the Lindbergh City Center project. The size and location of the parking decks, which serve both transit riders, workers, shoppers, and residents, was based on assumptions about the intensity of transit use by distance from the station. The majority of those living or working within 300 feet were assumed to walk; 40% of those within 2000 feet would walk; and most of those more than 3,000 feet away would take a shuttle bus. The city allowed a 30% reduction in parking because of the proximity of transit. Lindbergh Center has three parking decks for MARTA patrons, totalling some 2900 spaces

Downtown Silver Spring is a 22-acre mixed-use infill and rehabilitation project in an inner-ring suburb of Washington, DC. The Silver Spring metro station is located on one of Washington's first new subway lines, opened in 1979, providing direct transit access to downtown Washington DC in less than twenty minutes. It is also a major bus terminal, with extensive bus routes serving communities beyond the rail service area, making it one of the most accessible places by public transit, as well as by car. Not only is transit use by nearby residents high, but the transit share among workers is among the highest in the region.

Anchored by restaurants, retail, offices, public spaces, cinemas, and an existing Metro station, Downtown Silver Spring is the product of a public/private partnership between Montgomery County, Maryland and three Washington, DC private developers – the Peterson Companies, Foulger-Pratt, and Argo Investment Company. The project consists of approximately 440,000 square feet of retail, 185,000 square feet of office space, one hotel, multiple public parks, and 23 movie screens in two theaters. Featuring a traditional urban grid pattern oriented around two plazas, Downtown Silver Spring will eventually include a town square, a civic building, and a residential component. While the county developed and operated significant numbers of parking spaces, the new developments required even more to succeed for a new generation of shoppers. The project includes 3,858 parking spaces.

Architecture

Traditionally, the role of the architect has been to orchestrate all parts in the building process - from the broadest regional issue to the smallest detail - to achieve the highest possible quality in the whole. Structured parking has benefited greatly from systemization and pre-fabrication. Most are 'kit of parts' projects whose components are pre-selected and the architecture, in the narrow sense – the stairs, doorways and windows – is predetermined. For the purposes of this report, architecture is represented in the broadest sense, concerned with how to make parking structures ultimately successful, how to make them easy, even pleasant, to use; how to make the 'kit of parts' fit into a community 'like a glove,' and how to make them a community's proud asset, not an embarrassing liability.

Given the many difficulties the communities described in this report experience, making a parking structure 'successful… pleasant to use' and a '…proud asset,' is certainly a tall order - especially given how they are perceived by the public as having all the grace of a basement. Even more difficult, the public asks that parking structures disappear. An entire issue of Architecture magazine devoted to parking describes how "*parking occupies a passive place in the collective consciousness. Most people want garages and surface lots to be readily accessible, but invisible; they think of them as necessities, not amenities.*" (AIA 2001)

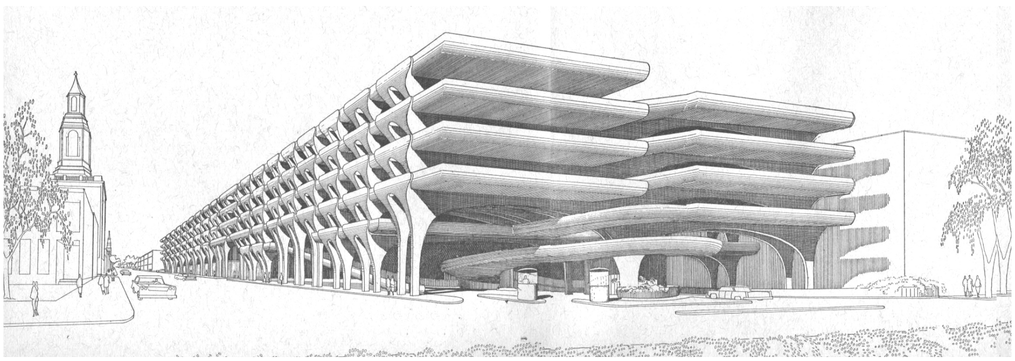
In order to overcome these seeming impossibilities, it is important first to understand that the parking structure was (and still is) an important structure in the development of modern architecture in the 20^{th} century, with many important figures designing them with many even influenced by them.

This section begins with the placement in a timeline of the modern **architectural tradition.** It continues with an inventory of the constituent parts of a parking structure including the **interiors, portals, towers** and **facades.** These can maintain a dignity and sophistication not often associated with parking structures. It concludes with a discussion of the overall **integration** of the constituent parts and other elements of their surroundings to fit 'like a glove,' and become noteworthy to a community.

Architectural Traditions

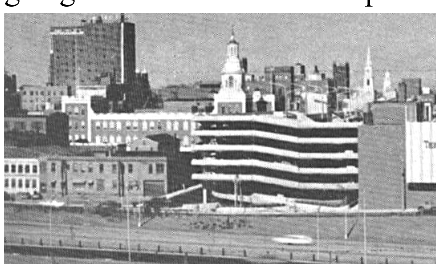
Although it might be difficult for some to imagine, few buildings are more emblematic of high modern architecture as practiced in the mid 20^{th} century than the parking structure. First, they closely follow the directive of 'form follows function'; they physically express what they are designed to do. In their bare form, there is nothing superfluous about them. Many modern architecture aficionados refer to them as 'honest,' exposing their structural systems with pride. Others call them 'heroic.' Second, they express their circulation system through their flowing ramps, as do many classic modern buildings by Frank Lloyd Wright, Le Corbusier and Oscar Niemeyer. Third, they are typically made from the material of choice of modern architecture: reinforced concrete.

Perhaps the finest example of the modern parking structure is the Temple Street Parking Garage of 1962 in New Haven, Connecticut, designed by Paul Rudolph. Rudolph studied under the Bauhaus master Walter Gropius at Harvard and when the garage was designed had been recently named the Dean of Yale's Architecture School. Having begun his career building refined, highly abstract homes from simple materials such as wood and plywood, Rudolph had joined other vanguard modernist architects in experimenting with the sculptural qualities of concrete. Sculptural here refers to using formwork to produce curvilinear rather than planar forms.

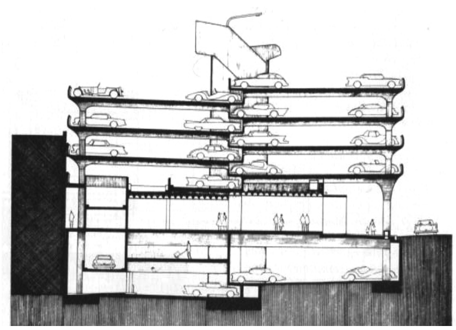


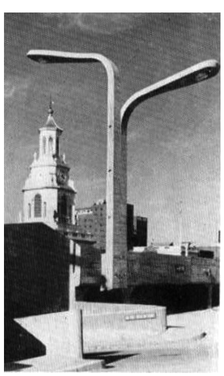
Temple Street Garage

Critics often refer to the resulting sinewy structure as muscular, and because it was so new and daring: heroic, even monumental. Rudolph carefully considered all aspects of the garage's structure form and placement. Located over a freeway, it acts as a major portal to



the city (left); the structure calls out to be seen and admired. Unlike today's prefabricated structures, Rudolph custom designed every detail at Temple Street, taking advantage of





tucking the hood of the cars below the adjoining deck to save space (right). The use of concrete made the structure seem like an extension of the freeway, except here the concrete is more refined; even the light poles on the top level of the structure are made from it (left). While its distinctive structure was like no other around it, the garage integrated with the city's streets including retail along its street frontage (Rudolph 1970).

The valorization of the parking structure by modern architects is consistent with modern planning, which too was automobile-based. In fact, many twentieth century architects, including the seminal Le Corbusier and Frank Lloyd Wright were influenced by the parking structure's form, deploying ramps throughout many of their buildings. The unique circulation system of Wright's Guggenheim Museum in New York City derives from one of his earlier, unbuilt, automobile-oriented project. The recently completed Seattle Library by Rem Koolhaas, which consists of a single ramping surface, is proof that this influence remains prevalent.

For the most part these heroic examples of modern parking garages have largely fallen out of favor, although there is some evidence that this strategy is being revived. Current practice in New Jersey and especially in downtown developments is to fall back on the demure viewpoint that parking should be "used but not seen." This also parallels a rebuke of modern architecture, first postulated by Robert Venturi (1966) that emphasized the "decorated shed", where a building's function and its cladding need not be related to each other. In contemporary parking structure design, this cladding takes many forms with the most popular being to disguise the buildings as other structures, typically housing (Klotz 1988). This strategy is consistent with that of the New Urbanists (described in the prior section) who place a primacy on maintaining a consistency of urban environment, which they argue must trump any expressions of function. Andres Duany, one of the founders of CNU, famously stated that "architecture should be sacrificed on the high altar of urbanism." (Duany 2000)

Regardless what period a work of architecture is from, it typically responds to universal principles. These principles are often referred to as architectural order, deriving from the original Greek orders – Doric, Ionian and Corinthian. Today, they consist of certain expectations that columns line up, that they are equally spaced, or that surfaces are perpendicular to others. Of course this system of order is often flaunted by designers, but not without a reason. Order is cited here to re-affirm that a parking structure is and will always be a work of architecture. Following architectural order, meeting expectations, will make them ultimately more usable.

Interiors

When designing parking structures, it is important to remember that even though a structures interiors are open to the elements, typically unadorned, and of an extremely awkward proportion of width to height of approximately ten to one, they are still worthy, arguably even more so, of architectural attention. However humble, the space of each ramp is still a room, in the same way that a street is still a room as discussed in the section on Urbanism, a room that has floors, walls, and ceilings.

ramp as room

The floors of parking structures are usually of concrete, either a poured in place slab or the tops of the prefabricated double T sections. These are often given a topcoat that gives them roughness to add traction. These floors will necessarily slope in ramped sections but their slope should be gradual and logical. These spaces are primarily for circulation whether by car or on foot and the pleasure of movement through them should nonetheless be considered. While speed bumps are often necessary, they should be clearly marked if used. Some garages employ ridges and valleys to assist drainage that causes a roller coaster effect for drivers. This should be avoided. Drainage can be adequately handled by a consistent slope either toward the center of the structure or toward its perimeter. Center drainage is often used to direct water to a single storm water main located along the structure's center column line. To direct water to a structure's perimeter, while slightly more expensive, has the advantage of preventing wind-driven rain (which often becomes ice) from coursing across an entire floor to find a drain. Perimeter drainage also follows the convention used in road design where the crown of a road directs water to a gutter. Because this is a convention, it is what people expect. This kind of familiarity, in its own small way, can make a space more pleasant.

The walls of a parking ramp are not unlike the walls of a home or building. Where possible, these walls should allow as much light to penetrate to the interior. Because the interior walls of parking structures often are required for lateral structural bracing, or shear walls, they tend to have few or no openings. This leaves the cross section of one aisle with parking on both sides to have one consistent cross section that is slightly more than 60 feet wide with the dimension to the bottoms of the beams as low as seven feet, depending on LOS (discussed in the section on Selection of Type). This leaves an awkward space of claustrophobic proportion made even more disorienting when the entire volume slopes by as much as 8 degrees. Arguably, it is even more imperative to use architectural strategies to ameliorate these awkward interiors by creating as pleasant experience as possible. This strategy begins with an understanding of the intrinsic, if not subtle, ordering qualities of the space.

First, all parking structures use columns (unless walls are entirely solid, which makes pleasantries even more difficult). Architectural designers refer to those columns as having a rhythm, as in music. This analogy is the source of the cliché phrase that "architecture is frozen music." Like a metronome, the spacing of the columns typically organizes the arrangement of windows, lighting or any other feature that appears in series. These are usually organized around an implied centerline between columns. For structural efficiency, columns are typically evenly spaced and the space between columns is typically referred to as a 'bay.' While some sophisticated contemporary modern designers play off these rhythms through syncopation or other methods that parallel the atonality of some modern music, in basic structures like parking decks, most would argue for a simple logical series of columns, windows, lights etc that like music, can be said to be harmonious. This translates to their being a consistent number of windows between each column and that lighting follow a similar consistency.

Second, the long low spaces of parking structures are designed for movement through them, not to linger. To follow the domestic analogy, they are corridors first and rooms second. To a driver, these 'corridors' are linked together, leading first to a space and then and to an exit. To those on foot, they are first the path to an exit and upon return the path to one's vehicle. The wide low ceiling cross section of this corridor is continuous and, in its most popular form, organized as a spiral. This spiral, or helix, coils like a rope, eventually ending in a roof or the structures highest floor devoted to parking. The curvature of the coil is typically not smooth, but segmented into a series of 90 if not 180 degree right or left turns. Often, these turns occur as sloped surface becomes flat or visa versa. As will be described in the next section, vertical circulation occurs adjacent to these turns, around which there is heightened activity. This part of the corridor is one of the most dangerous as the conflict between driver and pedestrian becomes most acute. Each can be surprised by the other when vehicles negotiate what is typically a blind turn. To distinguish this space architecturally through window arrangement or lighting can help decrease any disorientation associated with it.

Third, the spiral eventually terminates in a level open to the sky. Parking structures are likely the tallest around and its roof often provides expansive views. The transition from constricted, shadowy, claustrophobic volumes into daylight can be quite dramatic, whose drama was the basis of Frank Lloyd Wright's Automobile Objective & Planetarium for Gordon Strong in 1924, which was the prototype for the Guggenheim Museum (Reinberge 1984). Many consistently park there because they find the lower floors claustrophobic and uncomfortable. Others simply for the view. Beside the obvious aesthetic appeal, parking structure roofs must also respond to pragmatic concerns. Open to the elements, the majority of storm water a structure transfers originates there. Similarly, snow removal becomes a concern. For security and aesthetics, lighting must be pole rather than ceiling mounted.

Aesthetically, the roof is still a room in the sense that gardens can have rooms. Modern architects reclaimed the space of roofs and often built gardens there. To these architects, the roof became a building's fifth façade when viewed from an airplane. Since municipalities often re-program surface parking lots as flea markets or other kind of gathering spaces, parking structure roofs can be similarly transformed, although this must be considered in its design, as an assembly occupancy will require the top floor to withstand a greater load; twice that required of parking. One of the studio designs covered in Design Testing uses this strategy. On a smaller scale, the top of the vertical core could become a small coffee bar that serves regular commuters or those there for the view. In 2006, Johnson & Johnson placed photovoltaic panels on a metal armature above the roof level of its parking structure in downtown New Brunswick, using the power generated to offset that needed to operate the structure. Done for environmental as well as economic reasons, this suggest that given rising environmental awareness, the acreage of parking structure roofs will likely be reprogrammed in the future for uses such as green roofs. Two of the design testing proposal feature green roofs.

The ceiling of a parking structure's volume is the final surface to be addressed. Similar to walls where columns set up architectural rhythms, beams in a ceiling have similar attributes. In steel or poured in place concrete structures, beams often correspond to columns in frequency, but in the double T construction that is becoming increasingly common, beams occur at far greater intervals. With the depth of each beam close to equal that of the

awkward proportions – weight overhead

space in between and lighting occurring every fifth or sixth interval, driving beneath these shadowy beams can be disorienting. Walking under them, one feels their incredible weight only inches above. This is precisely the reason why many mall retailers who employ structured parking use very high clearances. Where cost or site constraints prevail, there is little one can do to lessen their impact (certainly there are those that find these spaces exhilarating) except by following the ordering strategies described elsewhere in this section, especially since ceilings are generally the location for many systems: lighting, electrical, drainage, signage, and where required by code, sprinklers and air ducts. To arrange these systems, especially lighting and signage, in between the staccato rhythm of the beams in a logical manner that reinforces how the structure is used will lessen disorientation and perhaps even begin to create a pleasant environment.

raw concrete, unfinished interior

Generally, all the surfaces described – floors walls and ceilings – of parking structures are of concrete and are often left unfinished to save cost. While the rawness of concrete appeals to architecture aficionados and has regained popularity (it is used as a finish material in many contemporary museums), its finishes are inconsistent and still triggers negative associations in parking structures. Painting is often an option, generally costing $1,000 dollars per space. Princeton's Mayor Reed considers it the Borough's most essential expenditure at the at the Spring Street facility. Indeed, light colored paint adds cheeriness as bright reflective surface enhance artificial and natural light. Painted surfaces are also easier to clean. Color coding of floors used as a mnemonic device to remember where one has parked can also add cheeriness as well as to subconsciously suggest location.

Portals

Every parking structure has one or more portals where vehicles enter and exit. Because of the scale of the communities this report focuses on, and the likelihood that a payment system will be encountered when exiting, it is recommended that a single portal be used and that it have other attributes clustered around it. The portals should be the nexus of activities including the parking management office, vertical circulation, payment machines, handicapped parking, retail and any other activity available. More activity is preferable to less.

parking management office adjacent to portal

Portals should be emphatic places of arrival as activity gives a sense of security and feeling secure makes a place more pleasant. The location of offices has several advantages. First, attendants provide vigilance against any unwanted entry, their presence alone gives a sense of security. By being near the gate, they can quickly resolve any issue regarding payment that might otherwise create traffic tie-ups. Finally, the presence of management puts a friendly face on what many associate with isolated or even threatening spaces.

Vertical circulation – stairs and elevators – bring pedestrians and hence activity to a portal. Pedestrians should enter and exit as near the vehicular entrance while maintaining safety to maximize activity at the portal. Stairs and elevator should be as nearby as possible immediately inside the portal and not separated from it by walls. Pay on foot machines should be prominently located nearby.

The Americans with Disabilities Act (ADA) stipulates the number of accessible parking spaces necessary for a parking structure's given capacity in Section 4.1.3(5)(a) of the *Americans with Disabilities Act Accessibilities Guidelines* (2002). The minimum number of spaces is graduated by size of facility, ranging from a highest percentage of 4% (1 accessible space in a facility of 1-25 total spaces) down through 2 % (for facilities of 501 – 1000 total spaces), and ultimately to slightly less than that for very large structures (20 plus 1 for every 100 spaces over 1000 for structures with 1001 or more spaces). Clustering these near the primary portal makes sense for a number of reasons. First, they are a welcoming gesture to those that need them. Second, the loading and unloading zones required adjacent to each stall gives a greater sense of openness around the portal. Third, there is a greater likelihood that these spaces will be unoccupied, adding to the sense of openness around the portal and providing a space where a puzzled driver can pause in to figure out how to pay.

The presence of retail in parking structures has already been described in the section on Urbanism. Where the situation allows, this retail could open directly to the interior spaces around the portal. These entries might likely be a store's secondary entry, but would still bring activity and even a lively display. Every measure should be used to make a portal's surroundings attractive and welcoming by creating hierarchical contrast with the rest of the facility. It should have brighter lighting, perhaps a different painting scheme, and if possible, increased headroom.

Towers

A parking structure's vertical circulation – stairs and elevators – serve important functional and regulatory purposes. These towers can also play an important aesthetic role in successfully integrating a structure with its surroundings. They typically rise beyond the highest deck level, and when an elevator is included, code and mechanical reasons combine to make them 23 feet higher. The resulting prominent vertical form is especially recognizable when juxtaposed with the structure's strong horizontality. The tower can be a key visual feature of a parking structure as many civic buildings such as town halls, train stations, firehouses and places of worship have towers associated with them. A parking structure's tower can be accentuated as they are on many modernist structures or suppressed especially when a parking structure is combined with another adjacent building. Whatever strategy is employed, they are necessary features whose physical form should be carefully integrated, never an afterthought.

tower as key visual feature

A parking structure's multiple levels require vertical circulation not only for convenience but also for emergency evacuation. Building codes require a minimum of two stairs as means of egress. Their number and the width is based on a parking structure's occupancy and the maximum travel distance to a stair is stipulated (as per the International Building Code (2006), intended to become the US standard, that maximum distance is 1200 feet). In "open" structures, stairs are not required to be enclosed like an egress or fire stair in a typical building, whereas "closed " structures require that stairs be surrounded by an enclosure with a two hour rating (the difference between open and enclosed structures is described in the section on Engineering).

Even when all accessible parking spaces are clustered at the portal, and even though all levels are connected by ramps, ADA requires that all floors of a parking structure be serviced by one or more elevators. Industry standards recommend an additional elevator for every 360 additional parking spaces (in a two tier structure in a retail integrated environment). This number can be higher (in an office or airport environment) or lower (for projects that include special events service – due to greater concentration of arrival/departure traffic – or a greater number of tiers). The elevator cab must be large enough to inscribe a five-foot diameter circle on its floor, the geometry required for someone in a wheelchair to turn around.

accentuated tower

The stairs, elevators and spaces around them should be generously dimensioned, well lit and cleaned regularly. Vertical circulation connected to the portal should be considered its extension through lighting and finishes. Unless building codes absolutely mandate, stairs should never be fully enclosed like a fire stairs. Fire stairs are seldom pleasant spaces. They are claustrophobic, full of echoes and have the capacity to concentrate smells, especially that of the last miscreant who was drawn to its enclosure to urinate. The second stair required must be of sufficient distance from that adjacent to the portal and must exit directly outside. It is unlikely that it would include a second elevator unless the structure exceeded 720 spaces (for a two tier structure). Practically speaking, this minimum number of spaces requiring additional elevators could decrease slightly as the number of tiers increases (If the form of the structure is 'many tiers of relatively few spaces each' than a greater percentage of pedestrian traffic will use elevators, and this greater traffic will require additional elevators for fewer spaces). Ideally, a structure's entire perimeter should be secure except for the entrances associated with both means of egress. This second stair does not benefit from the same level of activity as does the primary stair and its exit represents an unguarded point of entry. Nonetheless, its lighting and finishes should maintain the same standard as that of the primary stair. It should be patrolled regularly and monitored by close circuit television (see the section on Security) .

The corners of a typical parking structure cannot be used for parking cars because the space lacks access. For this reason, planners often locate vertical circulation in at least two of them. The unused corners can be used for mechanical equipment, or storing motorcycles or bicycles. To chose not to build floor area in these locations saves little because of the complexity added to structural framing. Although compelling reasons might locate vertical circulation at some midpoint along one or more sides, most times towers are located at a parking structure's corners.

corner tower

On a freestanding structure, locating a tower at the corners makes two perpendicular corners visible which further accentuates their verticality. Some designers even separate them to appear as if they are free standing. Industry guidelines recommend that stairs and elevators employ as much glass as possible for safety reasons. While it is unlikely that someone committing a crime will be apprehended because they were observed from afar, glass surroundings might deter them. More important, a sense of openness makes patrons feel more secure. Glass enclosed spaces that offer views are more interesting and barring those with a fear of heights, more pleasant to move through.

Many designers choose to make an aesthetic statement of the glass tower. Since good practice (already described above) makes them well lit, they can be situated to become beacons when seen at night. Figures ascending stairs animate the structures making them interesting to look at. Glass enclosed elevators animate the structures even more when deployed as they are in high tech modernist structures with lit capsule bobbing up and down. Safety recommendations usually restrict playful design creativity; it is rare when they encourage it. This rare convergence underscores the notion that the parking structure in its naked form can be an archetype of modern architecture, where simple pragmatic tendencies toward openness and transparency - literal and figural - can become their own aesthetic.

glass tower

Facades

Facades, or elevations, are the parts of parking structures that are presented to the surroundings. In their basic form, they include the sides of the 'tubes' described earlier that coil their way toward a roof, with the great mouth of the portal where cars enter, and with towers at the corners seemingly locking the form in place. In many locations, especially where there is no surrounding context, they are left unadorned. The 'architecture' is simply that which is pre-designed and comes from the prefabricator. Often these attributes, which have been refined through mass production, are all that is required and have an elegance in their simplicity. Nonetheless, they are at best generic. As Timothy Tracy of Desmond Parking stated: "one must pay extra for architecture."[5]

When structured parking is located in an established downtown environment, one with its own character, the default response is that it must be dressed accordingly in order to fit in. When analyzed, the need to 'clothe' the structure is driven by several concerns. First is its huge bulk, it is an intrusion on smaller scale buildings from the early 20th century if not the 19th. Another is the rawness of the concrete that prefabrication typically delivers, which is at odds with traditional materials and evokes the many failed 'brutalist' projects of urban renewal. Another is the relentlessness of its horizontality that can be a jarring contrast to the vertically oriented windows of nearby structures. The list can go on.

The clothing metaphor is perhaps apt to describe this section, where the 'nakedness' of the structure is considered inappropriate by many in the studied environs of the suburban downtown. Yet again, this design tendency toward parking structures is entirely consistent with the broader shifts in architectural theory. Robert Venturi repudiated the purity and honesty of a building like Paul Rudolph's Temple Street Garage in favor of a 'decorated shed' more in tune with popular tastes and accepting that 'Main Street is almost OK.' In this new era, it was appropriate, if not imperative, to 'clothe' a structure to meet the expectations of the public and to relate to its immediate environment.

The 'clothing' or 'dressing up' of the typical prefabricated parking structure can be as simple as painting or integrating materials such as tile or brick with those precast concrete components that form the outer enclosure of the structure. These components are typically the deep girders that carry the structural loads from the double T beans, and the columns that accept the girders' loads and transfer them to the foundations. The girders typically extend from the underside of the double T beams to at least the top of the slab if not extending further to serve as a 'guardrail,' the vertical surface that protects against falls. This combined surface, often more than six feet high is the primary surface to which a veneer of materials is added. These are typically factory applied and add the least cost when 'dressing up' a structure. It is important to note that this practice does not fundamentally change the profile of broad horizontal openings that extend the entire length of the structure.

The next step in complexity is to attach a complete façade to the prefabricated structure's

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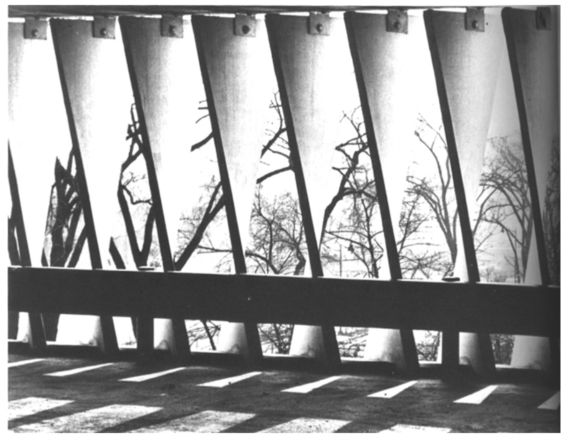
[5] Parking Symposium, Tim Tracy Presentation. January 28, 2005. Rutgers University School of Planning and Public Policy.

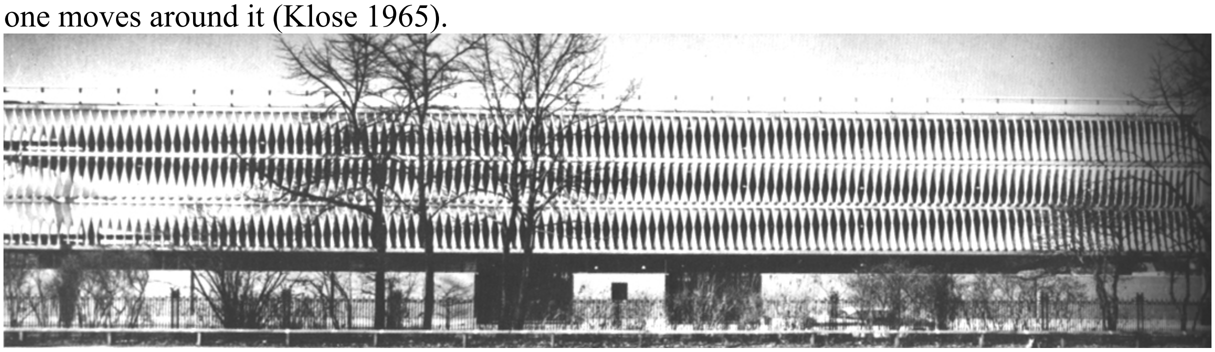
exterior girders and columns. These facades are referred to in construction parlance as 'curtain walls' because like fabric curtains, they are hung from supporting structure. Their only limitation, beside added cost, is the percentage of overall open area as specified previously in the section on Engineering. These facades can cover all or a select area of the structure's exterior vertical surface.

Curtain wall facades provide the greatest opportunity for clothing a structure and can take almost any form. Architects often refer to this element as a 'screen,' a choice of terminology that further underscores the desire to somehow shield or screen the parking structures presence from its surroundings. A screen by definition is a surface that is permeable, letting some degree of light, air, sound pass through it. Typically, the degree of permeability, or the percentage of open to closed, is consistent over the entire surface as in an insect screen on a window.



pre-cast louvers at Ford Hospital garage

Elements such as louvers, lattice or nylon scrim have all been used as "screens". Another modernist parking structure that many regard as a masterpiece is Albert Kahn's Henry Ford Hospital in Detroit, Michigan, where the structure is clad in a repeating pattern of twisting, pre-cast concrete vertical sections. While still allowing a view into and out of the structure, the combined surface offers a complex pattern of shade and shadow that animates itself as one moves around it (Klose 1965).



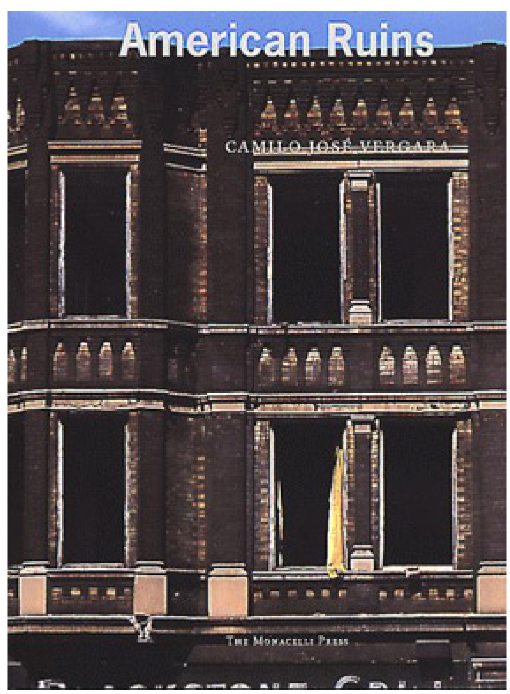
façade at Ford Hospital garage – effect of twisting louvers

Cladding a parking structure with a screen is a strategy that might satisfy both orthodox modern architects and post-modern followers of Robert Venturi alike, depending upon the nature of the screen. Critics such as Riley (1995), argue that the deployment of translucent screens represents an entire new generation of modern architecture. This generation's preoccupation is to make buildings alluring, even seductive, by slowly revealing itself. In this architectural form of strip tease, the screen is often referred to as a veil. The recent development of high performing nylon scrim, often used for advertising purposes on the sides of buildings or on scaffolding, is the ideal material for the veil. These surfaces can be printed with any graphic, hung over any surface in virtually any shape and can even accommodate framed openings within the surface. These systems cost approximately $6 per square foot ($+/- $50 per square yard) installed. In preparation for the 2000 jubilee year, the City of Rome cleaned most of its historic buildings. Covering the scaffolding, in many cases for entire blocks, were photographic representations of the buildings underneath.

The parking structure at the Turtle Back Zoo and Arena in West Orange, NJ incorporates large screens depicting animals in the zoo to drivers speeding by on the adjacent avenue. The opportunities offered by these screening systems have yet to be explored. Conceivably, the entire surface can depict a faux representation of its surroundings, likely to appall the architectural purists, or equally infuriating to others; the surface can be sold for advertising space.

nylon screen at West Orange

When the goal is to integrate with the immediate surroundings, these often mimic the proportion and orientation of nearby buildings. In a downtown, these are often domestically scaled vertical windows, whose orientation counteracts the relentless horizontality typical of parking structures. To further the illusion of domestic scale, these windows are often arranged as individual building elevations that simulate an entire block front of buildings. Including retail at the base only adds to this illusion. But this masquerade can only go so far. Code does not allow glass in the windows. These voids can easily be mistaken for abandoned buildings so common to distressed inner cities.



unglazed domestic scale openings in faux building elevation can be mistaken for …

Many municipalities find that this is the only possible strategy for convincing a reluctant constituency to allow structured parking. Those residents are fearful of change and disguising a parking structure as another form of building is a way to minimize anxiety. In Red Bank, NJ, Desman Parking Associates prepared elaborate diagrams of how its structure absorbed architectural features from numerous surrounding buildings. The proposal still withered under fierce community resistance. The Village of Ridgewood is on the road to success on its second attempt at developing structured parking with a proposal that mimics the village like atmosphere of its neighbors.

Walnut Street elevation in Ridgewood, NJ

Not surprisingly, the architectural academy and the press are aghast at this masquerade, The professors citing that it violates every practice taught in schools and the critics that these buildings are not worthy of their attention. Perhaps worse, given that the schools and the press are situated in large cities, their comments take the snide tone that these are the practices of 'rubes from the provinces.' To someone from New Jersey, a place that lies in the shadows of New York, where some have a cultivated an inferiority complex, these comments might sting; that is, if they are heard at all.

From another viewpoint, these disguised parking structures still carry the tradition of Robert Venturi's decorated shed, if perhaps taking it to its logical extreme. Venturi and his wife, Denise Scott Brown followed <u>Complexity and Contradiction</u> with <u>Learning from Las Vegas (1972)</u>, which idolized the kitsch of the Las Vegas strip calling for it to become a new architectural canon. That hotels such as New York, New York and The Venetian have located there and are thriving might indicate their prescience. A further counterpoint argues that this form of allusion has an extensive tradition in American Architecture from the false front facades of frontier towns (below) to the neo renaissance structures of the city beautiful movement to collegiate gothic at campuses such as Princeton. These 'popular' styles rarely appear in academic histories but are well known to many. Many garages that have used the masquerade strategy are considered successful and are well liked.

structure disguised as residential in Miami – complete with window boxes

To a community struggling to build structured parking, this debate might seem capricious and largely about style, or, to further the clothing analogy, about fashion. As hemlines and lapels might oscillate over the years, so to do building styles. What remains important is that the architectural cladding of a building reflects the values of those who build it. If a community is desperate to maintain that it is a small village and embarrassed about the enormous parking structure in its midst, then disguising it as something else may be their only alternative. The building of structured parking is a considerable investment and a civic gesture that should afford a community the opportunity to be expressive about itself. Rudolph's Temple Street Garage, after years of being maligned, was recently lovingly restored, recognized by its community as an authentic landmark. Had New Haven chosen not to restore it, instead to dress it up according to contemporary style, might the next generation feel compelled, when styles change yet again, to spend millions to again re-clothe it?

At Princeton University, two parking structures exemplify the evolution of cladding strategies. The older of the two, Prospect Avenue Parking Garage, was designed by the Boston firm Machado Silvetti and completed in 1993. The principals in the firm, both faculty at the Graduate School of Design at Harvard, employed a strategy of decorating and disguising the structure consistent with the then post-modernist, decorated shed theory. The facility sits on a street of stately eating halls and is set back behind a large pre-existing brick wall. The basic concrete and steel parking structure is clad using a combination of two systems. The first is one of ornate brick fashioned to evoke its neighbors (details above).

The second is a series of large metal mesh painted a forest green color, which are mounted atop the brick (right). These are meant to evoke trellises and lattices of garden structures. The lattice was intended to support ivy, hence making a laconic reference to the Ivy in Ivy League (wry humor is another attribute of post-modern architecture). This structure received numerous accolades including a National Honor Award from the American Institute of Architects. Unfortunately, the architects miscalculated the mesh's ability to sustain the growth of ivy, a plant that apparently cannot endure the heat that the metal absorbs from the sun. Introducing wood slats to the metal has had limited results. Ironically, the ivy has thrived on the brick obscuring much of its ornate features. Machado and Silvetti's miscalculation has not deterred other designers from using plant material as a screening device. The Miami Beach Garage (below) at 7th and Collins in Miami Beach, Florida has exhibited the opposite result from Princeton. There, the tropical climate has caused plant materials to become a dense mat making it difficult for light to enter. When shown in presentations, images of that facility often induce laughter.

Others, perhaps with an environmental bias, find it appealing. A parking structure in Charleston SC (right) with less growth evokes a pleasing reference to that city's porches, known locally as piazzas.

Across campus, the New South Parking Garage exhibits a more recent example of architectural screening. In this facility, Enrique Norton of Ten Arquitectos, based in Mexico City, clad a straightforward prefabricated structure designed by Walker Parking Consultants with stainless steel mesh. From a distance, the strong horizontality of the openings is clearly visible behind the mesh, although the mesh shimmers in the sun, giving the silver box a volumetric quality. This subtlety causes one to not perceive the parking structure for the basic structure that it is, but as something else entirely. Like a veil, the metal mesh makes that which is behind it more alluring. Norten also designed the elevator tower and bus station as unequivocally modern, using steel and large expanses of glass, some of it tinted orange for the university's colors. The Ten Arquitectos project also received an American Institute of Architects Award, the Gold Medal from the New Jersey Chapter in 2002.

New South Parking Garage in Princeton

While both award-winning structures use mesh as a screening device, the goals of each are fundamentally different. If the ivy had grown as Machado Silvetti intended, their garage would have been largely covered by vegetation. The ivy and brick's role was largely to obscure, to distract from the structures true function. Norten's highly machined cladding has the opposite effect, the shiny mesh veil calls attention to the structure, revealing with pride the simple building that it clads. Although superficially the two might be alike, New South, in its proud expressiveness is closer to Rudolph's Temple Street Garage than to its counterpart across campus. Arguably, the difference in strategy may have had to do with immediate context, but it reinforces the need for a community considering structured parking to ask itself an important question: given where we intend to locate it and who we are as a community, do we perceive this structure to be an asset, or a liability?

Integration

To succeed, all structured parking must ultimately integrate itself into its surroundings. In the previous section, it has been shown how this can oscillate between a structure arrogating itself as a monument, to one that conceals itself behind a veil that portrays it as something else. This final section on architecture discusses integration in cases where a parking structure is constructed as an ensemble of other buildings, thus furthering the theme of mixed use prevalent throughout this report.

The first question to ask in determining an integration strategy is what is *the context* with which to integrate? In a downtown environment, not all streets and spaces are equivalent. As discussed previously, a downtown includes primary and secondary streets and structurted parking should be located, where possible, on secondary streets. This does not demand that the structure stylistically relate to its immediate context . For example, most existing downtown surface parking is accessed from secondary streets. These lots are faced by the backs of buildings, whose elevations were never given great consideration. Structured parking need not echo these elevations to be contextual.

A parking structure is often so large that it seems more like a city block than an individual building. It is large enough that each side can be treated differently depending on the hierarchy of the streets or spaces it faces. When facing high quality streets, a parking structure might be perceived as an intrusion. Its design might warrant a higher degree of finish, as described in the previous section; or if space permits, it should integrate an entirely different structure (such as housing) whose elevation is in keeping with the nature of that street.

There is a long tradition of parking structures integrating with other buildings. The vertical office tower rising above several levels of parking is a common sight in American cities. What is less common is the downtown parking structure integrated with other structures, which because of a downtown's scale, is horizontal rather than vertical. These horizontal, or lateral, developments have been somewhat inhibited by the reality that parking structures and housing are funded by different lenders and it is sometimes difficult to coordinate the two. Otherwise, little precludes a parking structure from one or more of its edges being surrounded or "wrapped" with another building type, so long as certain technical parameters are met. The two structures need to be separated by a "two-hour wall," a building code designation that means a fire would be kept from burning through for two hours. In order that the vibrations from moving cars not migrate from the garage to the adjoining building, each should have separate building foundations. Because a parking structure can have solid walls on up to two of its faces and maintain its open classification, the garage itself would be no more expensive.

The garage and its wrapper are typically autonomous to one another. Even at the lowest LOS, parking structures have greater floor-to-floor heights than typical housing. To align the floors would make the housing less efficient and thereby more expensive. Recent projects that employ the full version of this strategy, wrapping housing around all four sides, all require exiting the garage completely before entering the residential portion. The developers of Liberty Harbor North in Jersey City, who also employ the full wrapper strategy, investigated whether to provide private garages for individual units. They ultimately rejected the idea because enclosed garages require more width than a typical stall.

Princeton's Spring Street Garage (described earlier), operated by the Borough and not the University, offers an excellent example of this integration strategy. Rather than cladding the structure with a green lattice or stainless steel mesh, it is partially surrounded by housing and benefits from integration in a larger composition that includes a pedestrian network, a public plaza, municipal library, stores and restaurants. The two exposed sides of the structure are clad with very simple and inexpensive materials designed to look like the surrounding context, with domestic scale openings punctuating the larger surface.

Consistent with mixed-use strategies described throughout this report, the programs that the surround the structure also rely on the garage for parking spaces. The structure also provides two separate entries at opposite ends, something this report argues against. Here it is effective as one entry serves the library, the other the principal streets of downtown. There is enough activity that a second entry does not become a security risk. The plaza area, the highest quality space of the ensemble, is entirely shielded from the garage. The plaza is the culmination of a Chambers Walk, a lovely pedestrian sequence through alleys lined with shops.

Spring Street garage / Witherspoon plaza mixed use elements

Architect's rendering of Spring Street garage / Witherspoon plaza

The older Witherspoon garage, built as part of the Palmer Square development in the mid-eighties, is an excellent example of a private shared-parking garage. It is completely hidden on two sides behind retail, office and restaurant buildings and topped by townhouses. Once the second phase of the Palmer Square development will be complete the parking decks will also be wrapped by town houses on the other two sides as well.

Hulfish Parking at Witherspoon in Princeton

Summary

- Determine the appropriate construction type given form and finances
- Understand construction implications of foundations and systems
- Effectively manage the construction cost estimating and construction management processes
- Deploy effective parking management information technologies
    - collect meaningful operational cost and revenue information
    - provide effective permitting and security
    - improve efficiency for customers, ease of use
- Employ Smart Growth and Transit Oriented Development principles
    - Density
    - Diversity
    - Design
    - Destination
- Design the facilities appearance using methods of integration and/or disguise and in the context of Architectural traditions
    - Interiors
    - Portals
    - Towers
    - Facades
- Integrate structured parking with programs that provide a better exposure to adjacent streets.

STEWARDSHIP

A well planned and designed downtown parking structure will not ultimately succeed without effective stewardship. Stewardship includes activities that are necessary to effectively maintain and nurture the facility once it is in operation, and to assure a long and effective service life. These components begin with **payment procedures**, which serve several crucial purposes. While primarily oriented towards assuring that the facility remains financially viable by capturing earned revenue, it also serves to assure access control, and to capture information on parking usage and habits that will inform future parking management decisions. **Security** systems and procedures are required to minimize the actual or perceived risk to the public associated with their use of the facility, and thereby assuring its intended utilization over the course of its service life. **Maintenance** procedures assure that proper and timely preventative actions are taken that reduce premature deterioration of structural elements and equipment failures and extend the facilities service life (Chrest 2001) (NPA 2004).

Payment Procedures

Access control, revenue control, and payment procedures are all interrelated, and their various forms can take on a 'mix and match' quality. Today, all transit related parking facilities are likely to be gated, utilizing some form of payment system to control access. The variety of technologies associated with gate access (magnetic stripe, bar codes, automatic vehicle identification and license plate recognition) were identified in the section on Access.

Where the structured parking shares spaces with daily users, such as retail patrons, Pay on Foot (POF) is rapidly becoming standard. Only by paying, typically at a machine before returning to one's vehicle when departing the facility, will the exit barrier arm be raised. There are many options available regarding how payment-on-foot is collected: ranging from having central cashiers only, to having automated pay stations only, to having some hybrid of central pay stations and exit cashiers, or pay stations and exit cashiers. Arguments can be made as to the pro's and con's of each solution, ranging from putting a human face on things, to cost effectiveness, to staffing decisions; however given labor cost, most garage operators typically automate where possible.

Design of POF systems requires careful attention. A key consideration involves changing the propensity of the American parker to leave their ticket in their automobile. Well designed signage in prominent locations in both parking and pedestrian areas can reinforce the message. Pedestrian traffic flow also influences the success of POF systems, which perform best when

well designed signage

patrons must pass through a single pedestrian access point to return to the parking area. This eliminates excessive automated machines or cashier locations. Finally, by placing exit lanes close to parking offices, problems with a transaction can be handled quickly and efficiently because parking supervisory personnel are nearby.

Security

Parking structure security minimizes the actual or perceived risk of incidents that threaten parking patron's safety and property. Psychology plays a big role as good design uses perception to influence people. The more secure a facility appears, the more likely it is that parkers will accept and use it. Parking structures are at somewhat higher risk of crime than the land uses they serve. Physically, they comprise a large volume of space with limited activity, parked cars provide hiding places and impede distribution of lighting, and sloping ramps often impede visibility. In terms of access, most facilities are necessarily open to the public. Additionally, they allow an ideal mode of escape – the private vehicle.

A recent development among security professionals and those concerned with reducing crime in cities is the recent adoption of the concept of Crime Prevention through Environmental Design (CPTED), which emphasizes the proper design and effective use of a creative environment to reduce crime and enhance the quality of life. All passive security measures (as defined below) incorporate CPTED concepts.

Of special focus in these times is a type of violent crime that presents special concerns for the design of certain types of parking facilities: terrorism. A common terrorist attack mode has been the car bomb, such as in the first World Trade Center attack in 1993. Often the attacks have occurred in parking situations, even though the target was the tenancy in the associated building (WTC, Murrah Federal Building in Oklahoma City). Special risk facilities also include federal buildings, and courthouses, whether federal or state. The Federal Aviation Administration imposes certain restrictions on parking facilities during heightened levels of security that impact parking facility design at airports. The Federal GSA has specific guidelines regarding security at Federal buildings, as does the State Department for embassies overseas.

The first step in security design is to perform a security audit. This is the process of assessing the general risk of incidents in the neighborhood, and the specific risk of incidents in specific areas of the facility. It is performed by developing an incident history, and establishing a risk classification profile of low- moderate- high-, or special risk. The second step is to evaluate actual and potential design features that impact security, either positively or negatively.

Security measures fall into two categories: passive and active. Passive security measures including lighting design, glass walled elevators and stairs are physical parts of the facility. These are inherently about visibility: the ability to see or be seen. Active security implies a timely response by employees of the facility, whether through security patrols or the use of closed circuit television (CCTV). Thirteen areas of focus for security design from passive to active are described below.

Structural design – use long spans as much as possible to enhance visibility. Use as high ceilings as LOS permits to enhance openness, and admit maximum natural light, which generally aids artificial lighting. Locate parking offices or security posts in the facility adjacent to entry portals. Locate retail adjacent to primary entrances and exits. Consider using traffic calming measures (speed bumps) to tame vehicle speeds.

Lighting – provide adequate lighting in all parking bays and pedestrian passageways, stairwells, etc. This is the most critical security feature.

Stair towers and elevators – construct them in as open a manner as code permits. If necessary to enclose, use glass for enhanced visibility. Use glassed backed elevators if located on exterior walls, etc.

Rest rooms – should be avoided entirely. If they are required, use maze type entrances without doors.

Perimeter security – locate attendants at, or visible to, pedestrian/vehicle control points. Use security screening or fencing at low activity points.

Landscaping/maintenance – Landscaping should be held back from the structure and used judiciously. Prune and trim regularly. Periodic upkeep is important: garbage removal equals active policing.

Signs and graphics – proper design and placement eliminates patron delays.

Cash security – use a drop safe and display signs declaring "cashier has no access" or "limited cash on hand".

Security patrols – keep patrols random and vary the routes. Assure personnel receive proper training, such as CPR, etc.

Emergency communications – provide panic buttons, emergency telephones, 2-way intercoms, 2-way radios.

Closed Circuit Television (CCTV) – serves as deterrent as well as detection and apprehension. Even fake CCTV cameras provide a real deterrent. Assure proper maintenance.

Security management – assure the existence of written policies, equipment checklists, incident catalogs, and that personnel adhere to policies.

Maintenance

The purpose of a maintenance program is to assure that proper and timely preventative actions are taken that reduce premature deterioration of structural elements and equipment failures. This, in turn, reduces future operating and maintenance costs. Parking facilities experience unusually harsh exposure conditions compared to most buildings. These include temperature extremes, dynamic loads, and de-icer application that can reduce the integrity of exposed concrete surfaces.

The maintenance needs of a parking facility are generally expressed in three broad categories, *structural*, *operational*, and *aesthetic*. *Structural* maintenance includes concrete floor slabs and surfaces, beams, columns, bumper walls, stairs and elevator towers, joint sealant systems, architectural sealants, exposed steel, and masonry. *Operational* maintenance includes regular and scheduled inspection and repair of items that can take the facility out of service or reduce user safety or security (parking equipment, elevators, electrical systems, HVAC, security monitoring, firefighting equipment), and routine cleaning including sweeping, washdown, and snow removal. *Aesthetic* maintenance includes landscaping, façade treatments, painting, and general appearance.

Maintenance actions can be categorized as *routine*, *preventative* (which tend to extend the facility service life), or *replacement*. *Routine* maintenance includes repairs of leaking sealant, clearing plugged drain lines, replacing damaged light fixtures, small area repairs of spalled or delaminated concrete, replacing expansion joint seals, cleaning/washing down floor surfaces. *Preventative* maintenance includes reapplication of surface sealers, traffic membranes, joint sealants and expansion joints. *Replacement* maintenance includes the replacement of structural and operational items at the end of their service lives, such as elevators, plumbing, parking access and control equipment. Tables 16 - 19 are sample maintenance checklists for daily, monthly, semi-annual, annual time periods.

Costs associated with maintenance need to be carefully considered. Indeed, while most owners and operators budget for the periodic repairs or corrective actions that maintain serviceability and facility operations (routine or daily maintenance), they frequently overlook replacement costs for structural and operational elements at the end of their service lives, or the cost of preventative maintenance actions required to extend the facility's service life. In fact, structural maintenance cost usually represents the largest portion of the total maintenance budget. Tables 20 and 21 present average annual maintenance costs for facilities of two different ages, and are illustrative of how the relative significance of various components of maintenance changes with the age of the facility.

Emerging Practices

In the context of stewardship there are several emerging practices that have both immediate application to enhance the transit parking experience and future potential to shape urban development in line with Smart Growth goals. These practices are the use of valet services and the growing trend towards car sharing.

Valet Services

Valet services are often employed during the construction of structured parking, especially when the garage replaces a surface lot and its regular users are displaced. These needs must be considered in the planning phase of a parking structure's development. But it is the use of valet services to enhance the transit parking experience on an ongoing basis that is to be considered here.

Valet services already exist in successful retail environments. Most commuters have been exposed to this service and may be familiar and comfortable with it. In the thriving restaurant and entertainment atmosphere of downtown Ridgewood, a valet service presently operates within two blocks of the train station.

Where shared parking is employed serving commuters, commuters arriving early may find no parking available. In this case commuters can simply leave their cars curbside and a valet moves it later when a space becomes available in the structure. The valet then simply logs the location on a locator card, which the commuter picks up with their keys when they return. Ideally the parking authority takes responsibility, and the service would be at no extra charge to a monthly parker. Valet parking can also be employed for those few occurrences a year that ITE minimums are designed for: for example, weekends during the Christmas shopping season.

The Village of Summit has had a commuter oriented valet service in operation since 2001. The intent of the program is to provide a curbside drop-off convenient to users who are willing to pay an additional fee, and to enable non-residents to obtain parking privileges. The city owns a nearby surface lot with 180 spaces, of which 120 had previously been reserved for non-residents. Recognizing the increased demand, the Village converted the lot to valet usage (the service is provided by an independent contractor subject to the bid process). Demand has outstripped supply, and the Village is presently negotiating to acquire more space.

Car Sharing

Car sharing is an emerging practice in urban areas across the US. Cars are made available in a convenience location on an hourly basis without involving a typical rental arrangement. Car sharing is a system where a fleet of vehicles is jointly owned by the users, as opposed to by a car rental company or by private owners. It is a key part of what is now called the New Mobility Agenda, which combines Transportation Demand Management (TDM) strategies and measures for containing, channeling and limiting private car traffic in cities, with support of a variety of alternative transportation arrangements including cycling, walking, public space improvement, electronic substitutes for travel such as telecommuting and a variety of shared and public transport strategies.

Car sharing is complementary to the goals and principles of Smart Growth as fewer parking spaces are required to meet the same driving needs, lower fuel consumption results in fewer greenhouse gas emissions and particulates, and older model cars are replaced with newer models which have more stringent pollution controls.

Other Smart Growth goals achieved are a significant reduction in congestion (one shared car replaces more than six privately owned cars), and significant increases in mass transit usage. The Car Sharing Network (www.carsharing.net), an industry trade group promoting the practice, reports some encouraging statistics from a variety of sources. In a study at UC Berkley, Susan Shaheen (2007) found that the number of trips among members made by mass transit grew from 35% before joining to 53% after joining.

Finally, car sharing promotes a deeper sense of community as members within a small geographic area share a common resource. That sense of community can be strengthened as the savings to members as the result of not spending some 13 -14% of household income on car ownership (estimated at $4,000 – 5,000 annually), is often spent locally.

Several car sharing organizations operate nationwide including Zipcar (www.zipcar.com) and Flexcar (www.flexcar.com), while some operate on a more localized basis. PhillyCarShare (www.phillycarshare.org) is a non-profit organization with hundreds of locations around the city and environs. In Washington, DC, the Washington Metropolitan Area Transit Authority (Metro) now offers car sharing at or near 61 of the 86 Metrorail stations, as well as many locations specifically convenient to Metrobus through a partnerships with Flexcar and Zipcar.

In New Jersey, Zipcar has several locations in Hoboken (including one within several blocks of the PATH station), as well as Jersey City, New Brunswick, and Princeton (one of the Princeton locations is the Spring Street Garage).

Summary

- Identify, install, and manage site appropriate PARC and POF systems
- Understand all potential security procedures, tools, and systems and install and manage as appropriate
    - active
    - passive
- Develop, implement, and manage appropriate maintenance procedures
    - structural, operational, and aesthetic
    - routine, preventative, and replacement
    - daily, monthly, semi-annual, and annual
- Determine if valet services are required or desirable, and institute as appropriate
- Determine if car sharing opportunities exist and engage providers as appropriate

DESIGN TESTING

The intent of design testing is to attempt to determine if the guidelines and strategies previously identified can be successfully employed in local, real world situations to mitigate the common inhibitors, or overcome the significant challenges, that stand in the way of a successful structured parking solution. Those common inhibitors are typically associated with the size and presence of parking structures, and with their integration into downtown environments. Each inhibitor, organized around concerns stated as questions, is discussed below.

The New Jersey towns that hosted the design testing were Red Bank, Ridgewood, Metuchen, and East Orange. These were selected by the NJ Transit and the project team based on recommendations by Planning Directors of northern New Jersey counties. A brief introduction to the towns and their unique characteristics and challenges, the results of a planning studio held at Rutgers, can be found in Appendix B. The specific elements of each proposed site solution, the results of an architectural design studio held at NJIT, can be found in Appendix C.

Design Challenges

<u>Relative Size</u>

From the perspective of size: how does a community deal with a built structure that is significantly taller or broader than anything in its vicinity, whose mass simply dominates its nearby surroundings? How can the introduction of a building whose mass implies urbanization be done in such a way that the host community that does not want to become 'urban', can be satisfied?

The Village of Ridgewood was already in the process of approving a four level garage at Walnut and Franklin Street At 48 feet tall, it exceeds the existing zoning height restriction by 3', and is taller than many, but not all, of the buildings in Ridgewood. It is significantly taller than any building in its immediate vicinity.

A similar situation exists in Metuchen where the Pearl Street lot has no immediate neighbors of any significant vertical scale. Additionally at Metuchen, the footprint of the existing surface lot is so large (approximately five acres) that if a structure were to cover all of it, it would have the compounded problem of horizontal massiveness in a context where none exists.

<u>Streetscape integration</u>

From the perspective of streetscape, what are potential proper treatments for a building whose very mass threatens to disrupt the fabric of the existing street scene in the community, whose purpose or function runs counter to the ambience or street life the community desires? How can that building be made to fit it? Is it appropriate to attempt to disguise the structure? Is it even possible to disguise it? With what might it be disguised, an imitation of its context? Can it be hidden from the street, wrapped with other program?

Strategies

The simplest strategy employs working in two dimensions only, that is to say, manipulating a parking structures façade to achieve a community's desire. These can range from the merely acceptable to the delightful (depending on who is delighted). More complex strategies involve working in three dimensions, manipulating the mass of the structure. These strategies always involve introducing new elements of program in addition to parking. The most complex strategies involve going beyond the introduction of new program, to actually integrating the parking structure proposal into wider urban development initiatives. Examples of this wider approach are included in proposals of all four study communities.

In East Orange, Mounir Tawadrous proposed a superblock, whose components included an entertainment, shopping, dining, and housing complex, in addition to structured parking. In such a context, the parking is just one element of a rather large complex.

In Ridgewood, Rob Holmes proposed consolidating parking from several surface lots into one, and then leveraging the efficiency of that parking via a robotic solution. This provides more spaces than originally existed, in a footprint far smaller than previously used. The intent of this solution is to free up one lot entirely for development as a higher urban use by selling development rights. In Ridgewood, the focus would be "we're developing a community asset, a hotel on the green," not "we're building a big, ugly parking garage."

In Metuchen, Tony Okoye took a regional perspective that sought to enhance the connectivity of both the commuter path and the green spaces in the immediate vicinity. Tony proposed utilizing the upper deck of the parking structure for civic purposes (flea market, drive in movies, etc). on weekends and possibly evenings. Adjacent facilities would be a home base of a recreation facility/fitness biking trail.

Also in Metuchen, Walter Ksiasak proposed a broad set of additional uses that included public (performing arts) and civic (veterans center) uses, in addition to housing and retail, composed about a formal public plaza.

In Ridgewood, Scott Graham sought to integrate a broader development initiative by proposing a specifically civic use; that the Village relocate its library to a CBD location and use it to shield the robotic facility from the street. This proposal differs from the following proposals largely by the type of program it integrates (civic), and that it moves existing program from another location, rather than introducing new uses.

Integrated Program / Mixed Uses

Many proposals suggest wrapping the parking with additional program in order to mask the parking. Examples of this, with varying degrees of integration, include Vidal Guzman at Red Bank, Daniel Bakogiannis at East Orange, and all three Ridgewood proposals, Scott Graham, Ken Sirower, and Rob Holmes.

At Red Bank, Vidal Guzman proposed a solution on a NJ Transit lot, directly adjacent to the station. He placed the parking structure along the tracks and wrapped its exposed elevations, grade to top, with three other elements; housing units, retail at grade, and a child care facility. This parking facility is nearly completely hidden. One wide side is visible only from the tracks, one narrow end is dedicated to access and egress, and the other two sides appear as housing units (or nursery) over retail. A nursery is an ideal transit village program, as commuters can drop their children off on the way to work, and pick them up upon return.

At East Orange, Daniel Bakogiannis employed the same strategy on a much larger scale. Taking an 8.5-acre urban block and splitting it into two, he was left with eight street frontages to consider. By wrapping retail at grade, housing above, a new recreation center anchoring one corner, and restructuring a supermarket already existing on the site at another, he was able to have six of the eight frontages show no evidence of parking at all. On one of the remaining frontages, because of the scale of his proposal, the parking entrance/exit portals themselves take up a minority percentage of the street façade. On the last of the remaining frontages there is one side of parking exposed (a narrow end of a standard helix, and an ancillary deck for residents) and the portals themselves. But he mitigates all of this by orienting the access side to the tracks, and keeping the street life composition to the community side.

In Ridgewood, Ken Sirower proposed a standard two-way threaded helix structure, where one long side is set back from Walnut Street by a row of retail at grade units. One short end is set back from Franklin Street by a few housing units over retail at grade. The second long side (which also includes the exit portals) is unexposed to the street by virtue of the need to maintain an emergency access road at mid block (and access to the rear of commercial establishments on Oak Street). The second short side (which also includes the entrance portals) is unexposed to the street by virtue of the access road that also serves the rear of establishments fronting East Ridgewood Avenue. As a result, no parking entrance and exit facilities are evidenced on the street, other than signage necessary to direct parkers into the access alley from Walnut. The only evidence that this facility is not part of the local context of retail, dining, and housing, is the treatment of the façade above the new retail units along Walnut Street. The illuminated, opaque channel glass effectively shields the street from any evidence of parking, but is not contextually consistent. This element could be replaced with a different treatment of virtually any material, and still function. This proposal is the most complete in terms of hiding the parking from the street.

In the remaining Ridgewood proposals, both Scott Graham and Rob Holmes hide the parking from the street by using a robotic solution, but the necessary entrance and exit portals (multiple) make the existence of parking evident. In Scott Graham's solution, the entire parking activity is removed from Hudson Street by the depth of the library/terrace/café/office program that fronts the street, but he celebrates the parking event by making the robotic function transparent to library patrons and passers through. In Rob Holmes's solution, some of the robotic parking storage bays are at street front, but at one level above the window box advertising functions, and, shielded by opaque channel glass the parking is made, at once, both evident and the subject of some mystique.

Size Mitigation

One strategy is to simply 'commonize' the height of the parking structure. This means to keep the scale reasonable for the surroundings (not significantly larger than existing), and then to create new surrounding context that is consistent with the parking structure itself. This strategy is most evident in the Red Bank proposals of Alok Sakseena and Leslie Marchio. One can observe that the parking structures are specified at three or four levels, respectively, and that the new housing created immediately adjacent is effectively the same height. As a result, the parking structure does not appear obtrusive.

An alternative way to "commonize" the scale is to attempt to keep it down to the scale of the existing context. At Metuchen's Pearl Street lot, the existing footprint is so large that a structure of any significant number of levels would simply be too massive for the surroundings. The proposals of both Tony Okoye and Michael Marmion sought to mitigate this potential problem by keeping their proposed decks to two levels. The surrounding, or wrapping, program, at three or so levels, is thus not imposed on by the parking structure.

Summary of Proposals

The following list is a summary of the student proposals by component. This list can be used in conjunction with the findings that follow, and as a cross reference to the details provided in Appendix C.

i) <u>Primarily housing (some retail and other):</u>

Red Bank – Alok Sakseena
Red Bank – Leslie Marchio
Metuchen – Michael Marmion
Metuchen – Tony Okoye
East Orange – Daniel Bakogiannis

ii) <u>Primarily retail (some housing):</u>

Ridgewood – Ken Sirower

iii) <u>Additional program integration:</u>

a) Nursery – Red Bank – Vidal Guzman
b) Library – Ridgwood – Scott Graham
c) Civic/Performing Arts/Non-Profit (Veterans) – Metuchen – Walter Ksiazak
d) Recreation – East Orange – Daniel Bakogiannis
e) Hotel – Ridgewood –Rob Holmes

iv) <u>Broader urban initiatives:</u>

a) Mega entertainment complex – East Orange – Mounir Tawadrous
b) Development rights sale – Ridgewood – Rob Holmes
c) Greenway/recreation/parks connect - Metuchen – Tony Okoye

Findings

<u>Streetscape integration</u>

Additional mixed use program

This study concludes emphatically that the inclusion of additional program uses in a structured parking development project, even in a project specifically designed to resolve transit parking supply issues, is the (wisest) preferred approach. Inclusion of additional and varied uses addresses effectively and positively many concerns.

As articulated by Jane Jacobs in the classic <u>The Death and Life of Great American Cities</u>, two of the four conditions that generate the diversity necessary to sustain the vibrancy of downtowns are: *mixed primary uses*, and sufficient *concentrations of people*. These proposals all incorporate, to some degree, a mix of the most important primary uses: residential, work, and retail (commerce). But they also introduce additional, creative uses that appear to have a natural synergy with the transit experience. These include day care and fitness centers, but also can include more general uses such as municipal services (library) and other civic uses (performing arts, veterans' center).

The inclusion of housing, specifically, provides the pool of people required for sufficient concentration, particularly in the evenings, when the concentrations created during business hours by the presence of retail have subsided. It is this complementary mix, that assures a level of activity that is balanced throughout the day, that promotes vibrancy and urban health.

Additionally, the inclusion of housing, specifically, is the most synergistic fit for the developer implementing transit-oriented principles. While parking is naturally available for new residents, the new residents also form a natural pool of transit riders.

Finally, the integration of elements other than parking; such as housing, dining, and retail make financial sense as well. The inclusion of additional program provides revenue streams that enable the cost of parking to be subsidized so that the users or the community don't suffer the "sticker shock" associated with the real cost of parking.

Façade treatments

This study finds that integrating the facility into the streetscape by simply manipulating the façade is the less preferred approach, but recognizes there are some situations when it is the only alternative. It is lesser preferred because it does not address the opportunities cited above; vitality, density, strategic, and financial. In instances where the site is constrained, because of either limited dimensional flexibility or existent finely grained context (small scale), it may be the only solution.

Structured parking should engage with its surroundings. There are many cosmetic strategies that can be deployed, but few are universally acceptable. Some strategies manipulate the proportional elements of the façade, for example, including scalar elements, such as window-like openings to break down a garage's mass, or introducing vertical elements to relieve the overwhelmingly horizontal proportions of the garage and create some commonality between it and the typical downtown building. Other methods include constructing false fronts that mimic the surrounding context, or simply shielding the view of the cars with a variety of materials. Some garages have used natural plant materials (ivy) with varying degrees of success. The two proposals in this study whose façade treatment was a significant component of the solution were both in Ridgewood; one by Ken Sirower at the Walnut Street lot, and one by Rob Holmes at the Hudson Street lots. In each case, the students chose cladding materials that they believed would resonate with the specific community. In the first case, channel glass could be illuminated from the interior creating an attractive lantern-like effect that would highlight the adjacent "Ridgewood Walk." In the second, opaque channel glass punctuated by small Tiffany-like display openings of clear glass would permit a muted awareness of activities within, while creating a jewel-box setting for this affluent community's automobiles within. In any event, beauty is in the eye of the beholder; each community should design how their garages engage with their downtown surroundings.

There are two alternative approaches that can be exercised when the site is too impacted to make a mixed use project a possibility. One is to make the construction of the garage part of a larger urban initiative, such as Rob Holmes proposal at Ridgewood's Hudson Street lots, and the other is to use a robotic solution as in both Rob Holmes's and Scott Graham's solutions at the same location. Robotics is discussed in the section on Engineering of this study, and wider urban initiatives will be discussed below.

Size mitigation

This study concludes that there are three potential strategies to mitigate size concerns associated with structured parking facilities. These strategies represent a spectrum of possibilities as to the ease of execution, and their likely degree of community and political acceptance.

The first, most obvious, most executable, and most likely broadly acceptable, is to construct the facility in common size with its context. This method is demonstrated in the Metuchen proposals of Michael Marmion and Tony Okoye, and the and the Red Bank proposals of Alok Sakseena, Leslie Marchio, and Vidal Guzman. Structures that do not impose on their surroundings are least likely to generate community protest.

The second strategy is to actually make the facility physically smaller via a robotic solution. This method is demonstrated in the Ridgewood proposals of Rob Holmes and Scott Graham. As noted earlier, while this method has great promise, and is used elsewhere around the world, it is not without its detractors, and is likely to face some community reluctance and engineering skepticism.

The third strategy is to “supersize” the parking, to frankly celebrate its function by making it a feature of a large scale, broader urban development initiative. This method is explored in the East Orange proposal of Mounir Tawadrous. This strategy has significant limitations, including limited opportunities for execution, significant financial and investment implications, and potentially significant political and community ramifications.

Financial impact of housing integration

This study indicates that housing is a particularly effective program choice to integrate with parking, for both financial and strategic reasons. First, housing provides a subsidy for parking costs. An examination of the pro formas in the Red Bank proposals and the Metuchen reveal the potential impact dramatically. Leslie Marchio projected sales revenue in her Red Bank proposal, based on market conditions and housing type, of approximately $51M, and annual retail lease income of $2M. With estimated project costs of approximately $18M for parking, $21M for housing and retail, and $4M for the underpass reconstruction, it is clear to see the role of the housing component in making her project viable. Alok Sakseena’s proposal includes a revenue stream derived entirely from housing rental income (or sales income if a condominium approach is used) and projects self-liquidation in five years. In the Metuchen proposal of Michael Marmion, the housing/retail component of annual revenue is approximately 47%, while their portion of project costs are only 39%. It is intuitive that the non-parking component of the project is the most profitable, and that without it the project would be financially infeasible.

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TABLES

Table 1 <u>Parking Requirements Procedure – Downtown Mixed Use Projects</u>

(Source: Greenbaum, Rowe, Smith, Ravin, Davis & Himmel LLP).

1. <u>Determine minimum parking requirement / Individual uses</u> - The minimum number of parking spaces that are to be provided and maintained for each use shall be determined based on following parking factors:

Residential	1.4 per unit
Office	2.9 per 1,000 SF
Retail / Commercial	2.7 per 1,000 SF
Hotel	1.3 per room
Restaurant	0.3 per seat
Movie Theater	0.3 per seat
Conference / Convention	5.0 per 1,000 SF
Place of Worship	0.2 per seat
Other	Per APA Parking Standards

2. <u>Adjust for shared parking</u> - The minimum parking requirement for each use shall be multiplied by an "occupancy rate" as determined by a study of local conditions (or as found in the following "Occupancy Rate" table), for each use for the Weekday night, daytime and evening periods, and Weekend night, daytime and evening periods respectively.

Occupancy Rate Table (Source: Victoria Transport Policy Institute)

	M-F 8A-6P	M-F 6P-12A	M-F 12A-8A	Sat / Sun 8A-6P	Sat / Sun 6P-12A	Sat / Sun 12A-8A
Residential	60%	100%	100%	80%	100%	100%
Office	100%	20%	5%	5%	5%	5%
Retail / Commercial	90%	80%	5%	100%	70%	5%
Hotel	70%	100%	100%	70%	100%	100%
Restaurant	70%	100%	10%	70%	100%	20%
Movie Theater	40%	80%	10%	80%	100%	10%
Conference / Conven.	100%	100%	5%	100%	100%	5%
Place of Worship	10%	5%	5%	100%	50%	5%
Other (note 3)						

Note 1 This table indicates the percent adjustment of the minimum parking requirement during each time period for shared parking.

Note 2 Percentages set forth in the Occupancy Rate table are set to include a small "safety margin" of parking beyond that minimally needed to serve an average peak demand. Therefore a local study of parking demand may yield a greater reduction in parking required.

Note 3 "Other" occupancy rates as demonstrated by applicant via parking study or other credible evidence.

Table 1 continued Parking Requirements Procedure – Downtown Mixed Use Projects
(Source: Greenbaum, Rowe, Smith, Ravin, Davis & Himmel LLP).

3. Tabulate minimum parking requirement for each time period – Sum up the adjusted minimum parking requirements of each land use for each of the six time periods to determine an overall project minimum parking requirement for each time period.

4. Determine minimum parking requirement / Project - The highest of the six time period totals shall be the minimum parking requirement for the mixed use project.

5. 100% of the parking supply shall be provided within 400 feet of an entrance to the proposed building(s) it will serve unless waived via terms of item (6) and / or (7), below.

6. Other parking spaces in the vicinity of the project may be used to satisfy portions of the minimum parking requirement if the applicant can secure such parking through lease or other similar terms or if it can be demonstrated through study that certain public parking areas are typically vacant during the peak demand period of the project or will become vacant as a result of removals or demolition, all subject to the approval of the municipality.

7. If the parking requirement, or portions of the parking requirement, cannot be met, developers may purchase relief at the 2006 rate of $15,000 per parking space. This fee will be deposited into the Municipal Parking Improvement Fund to be used exclusively for the development, improvement or maintenance of public shared parking in the redevelopment district.

Table 2 Parking Garage Financing Decision Tree

(Source: Greenbaum, Rowe, Smith, Ravin, Davis & Himmel LLP).

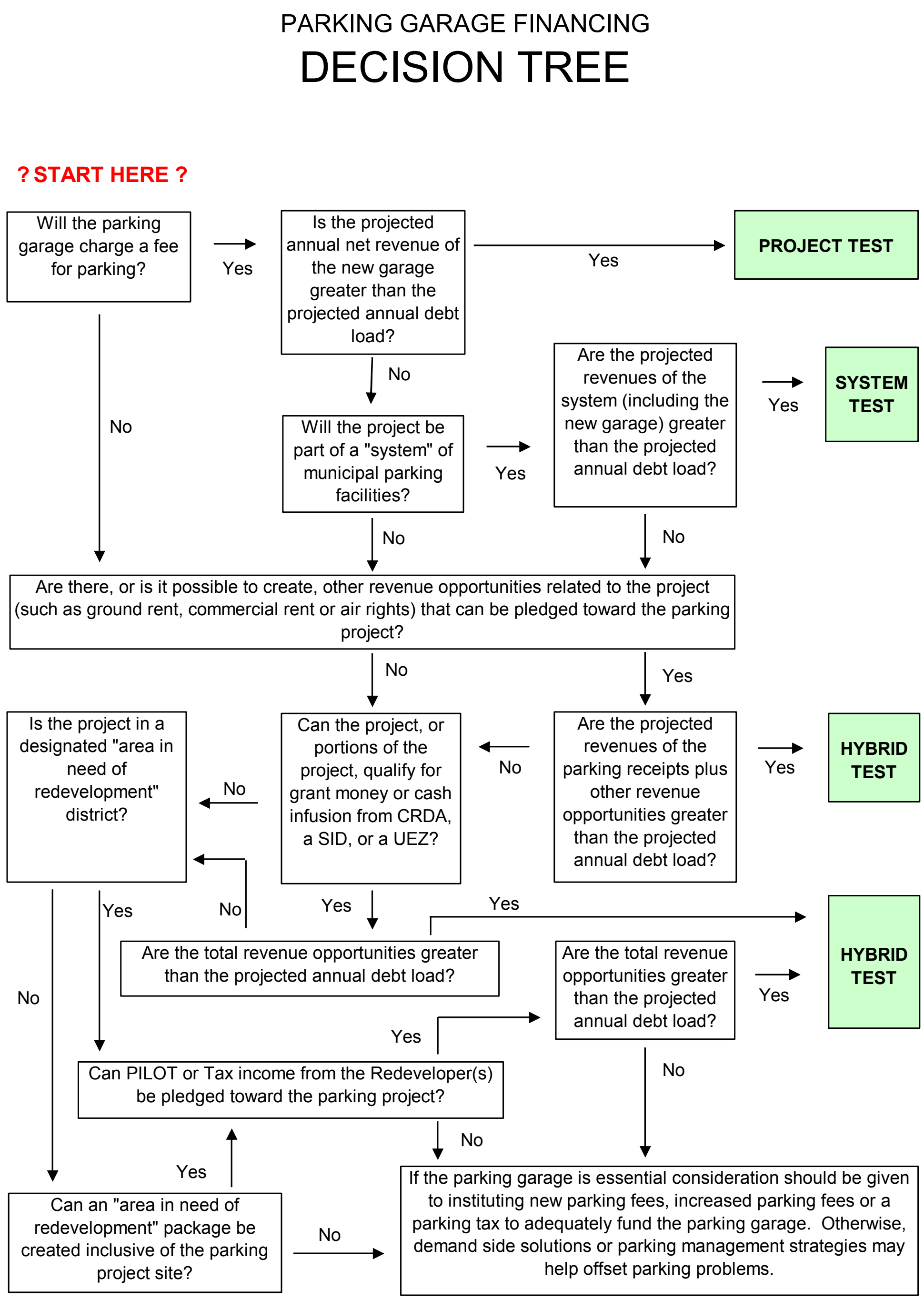


Table 3 <u>Parking Structure Estimated Conceptual Stage Costs</u>

(January 2006: N.J).

(Source: New Jersey Institute of Technology, Department of Civil Environmental Engineering).

ITEM	COST	UNIT
Precast concrete parking structure	**$80**	**$/Sq. ft.**
Residential (low rise) Stick Construction	**100**	**$/Sq. ft.**
Residential (low rise) Masonry Construction	**125**	**$/Sq. ft.**
Retail Stick Construction	**100**	**$/Sq. ft.**
Retail masonry Construction	**125**	**$/Sq. ft.**
Retail (stick or masonry) Built Out	**25**	**$/Sq. ft.**
Deep Foundation – Piles	**20**	**$/Sq. ft. Built over area**
Architectural Treatments	**30**	**$/Sq. ft. Frontage surface area**

Table 4 Level of Service Criteria

(Source: Chrest, et al,. Parking structures, 2001, pg. 39).

Design Consideration	Chief Factor	Acceptable Level of Service D	C	B	A
Turning radii, ramp slopes, etc.	Freedom to maneuver	Employee			Visitor
Travel distance, number of turns, etc.		Visitor			Employee
Geometrics	Freedom to maneuver	Employee..			Visitor
Flow capacity	v/c Ratio	Employee			Visitor
Entry/exits	Average wait	Visitor			Employee

Table 5 <u>Recommended Parameters for Wayflnding</u>

(Source: Chrest, et al,. Parking structures, 2001, pg. 45).

Design Standards For:	United States (English Units)			
	LOS D	LOS C	LOS B	LOS A
Maximum walking distance				
Within parking facilities				
Surface lot	1400'	1050'	700'	350'
Structure	1200'	900'	600'	300'
From parking to destination				
Climate controlled	5200'	3800'	2400'	1000'
Outdoors, covered	2000'	1500'	1000'	500'
Outdoors, uncovered	1600'	1200'	800'	400'
Clear height[1]				
Beam/slab construction[2, 3]	7'0"	7'8"	8'4"	9'0"
Other construction types[4]	7'8"	8'4"	9'0"	9'8"
% spaces on flat floor	0%	30%	60%	90%
Maximum distance to open side[1]	250'	200'	150'	100'
Light court/yard width:height ratio	1:4	1:3	1:2	1:1
Parking ramp slope	6.5%	6%	5.5%	5%

[1]Minimum straight vertical clearance to any construction (signs, lights, piping, structural elements, etc). Structures will typically be signed with 2" to 4" less vehicular clearance Van accessible spaces under ADA require 8'2" minimum vertical clearance.

[2]Minimum 15' between beams in any direction.

[3]LOS D clearance for P/T design set by minimum 7'0" overhead as required by all codes.

[4]Precast tees, waffle slab, fiat slab, etc.

[5]From any point on the floor to an opening on a side qualifying as open under the prevailing building code.

Table 6 Parking Geometries Legend

(use with table 7)

(Source: Chrest, et al,. Parking structures, 2001, pg. 74).

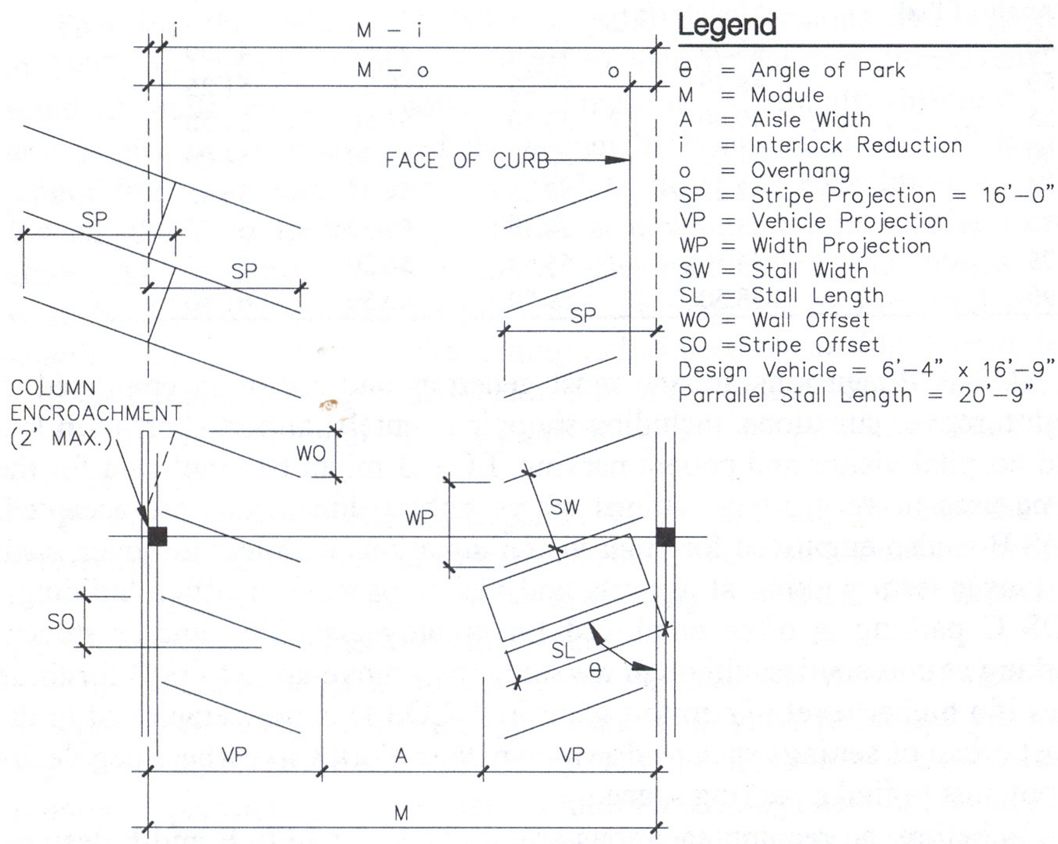


Table 7 <u>**Parking Layout Dimensions (North America)**</u>

(Source: Chrest, et al,. Parking structures, 2001, pg. 75).

All Levels of Service									
θ	VP	WO	O	SO	Design Vehicle = 6'-7" x 17'-1"				
45	17'-5"	10'-8"	1'-9"	16'-6"	Stripe Projection = 16'-6"				
50	18'-0"	9'-4"	1'-11"	13'-10"	Parallel Stall Length = 21'-6"				
55	18'-5"	8'-3"	2'-1"	11'-7"					
60	18'-9"	7'-2"	2'-2"	9'-6"					
65	18'-11"	6'-1"	2'-3"	7'-8"					
70	19'-0	5'-0"	2'-4"	6'-0"					
75	18'-10"	3'-10"	2'-5"	4'-5"					
90	17'-9	1'-0"	2'-6"	0'-0"					
0	**WP**	**M**	**A**	**I**	**0**	**WP**	**M**	**A**	**I**
Level of Service A					**Level of Service B**				
45	12'-9"	49'-6"	14'-8"	3'-2"	45	12'-4"	48'-6"	13'-8"	3'-10"
50	11'-9"	51'-3"	15'-3"	2'-11"	50	11'-5"	50'-3"	14'-3"	2'-10"
55	11-0"	52'-6"	15'-8	2'-7"	55	10'-8"	51'-6"	14'-8	2'-6"
60	10'-5"	54'-0"	16'-6"	2'-3"	60	10'- 1"	53'-0"	15'-6"	2'-2"
65	9'-11"	55'-3"	17'-5"	1'-11"	65	9'-8"	54'-3"	16-5"	1'-10"
70	9'-7"	56'-6"	18'-6"	1 '-6"	70	9'-4"	55'-6"	17'-6"	1'-6"
75	9'-4"	57'-6"	19'-10"	1'-2"	75	9'-1"	56'-6"	18'-10"	1'-2"
90	9'-0"	61-6"	26'-0"	0'-0"	90	8'-9"	60-6"	25'-0"	0'-0"
Level of Service C					**Level of Service D**				
45	12'-0"	47'-6"	12'-8"	3'-0"	45	11'-8"	46'-6"	11'-8"	2'-11"
50	11'-1"	49'-3"	13'-3"	2'-9"	50	10'-9"	48'-3"	12'-3"	2'-8"
55	10'-5"	50'-6"	13'-8	2'-5"	55	10'-1"	49'-6"	12'-8	2'-4"
60	9'- 10"	52'-0"	14'-6"	2'-2"	60	9'-6"	51'-0"	13-6"	2'- 1"
65	9'-5"	53'-3"	16-5"	1'-10"	65	9'-1"	52'-3"	14-5"	1'-9"
70	9'- 1"	54'-6"	16'-6"	1'-5"	70	8'-9"	53'-6"	15'-6"	1'-5"
75	8'-10"	55'-6"	17'-10"	1'-1"	75	8'-6"	54'-6"	16'-10"	1'-1"
90	8'6"	59'-6"	24'-0"	0'-0"	90	8'-3"	58-6"	23'-0"	0'-0"

Notes:

1. All dimensions rounded to nearest inch.
2. Add 1ft. to module for surface parking bayswithout curbs or other parking guides (frequent pole, columns or walls) in areas with frequent snow cover.
3. Angles between 76 degrees and 89 degrees not recommended because these angles permit drivers of smaller cars to back out an exit the wrong way.
4. To maintain the same level of service with wider stalls, reduce the module (M) by 3 in. for each 1 in. additional stall width.
5. Colums and light poles may protrude into the parking module a combined maximun of 2 ft as long as they do not affect more than 25% of the stalls in the bay.
6. Small car only stalls 7'-6" wide by 15'-0" long should only be used at constrained locations or in ramnants of space. The number of these stalls should not exceed 15% pf the total capacity.

Table 8 <u>Typical Peak-Hour Volumes</u>

(Source: Chrest, et al,. Parking structures, 2001, pg. 84).

	Volume in 1 hr[1] as % of static capacity			
	Peak A.M. Hour		Peak P.M. Hour	
Land Use	In	Out	In	Out
Residential	5-10	30-50	30-50	10-30%
Hotel/motel	30-50	50-80	30-60	10-30
Office	40-70	5-15	5-20	40-70
General retail/restaurant	20-50	30-60	30-60	30-60
Convenience retail/banking	80-150	80-150	80-150	80-150
Central business districtz	20-60	10-60	10-50	20-60
Medical office	40-60	50-80	60-80	60-90
Hospital				
Visitor spaces	30-40	40-50	40-60	50-75
Employee spaces	60-75	5-10	10-15	60-75
Airport				
Short-term (0-3 hr)	50-75	80-100	90-100	90-100
Mid-term (3-24 hr)	10-30	5-10	10-30	10-30
Long-term (24+ hr)	5-10	5-10	5-10	5-10
Special event	80-100	85-100		

[1] As a general rule, the larger the facility and/or the more diverse the tenants of the generated
land uses, the lower the peak-hour volume as a percentage of the static capacity.

[2] It is generally more accurate to determine what portion of the spaces are
allocated to retail office, and other uses.

Table 9 Flow Capacity of Circulation Elements

(Source: Chrest, et al,. Parking structures, 2001, pg.86).

	Theoretical Maximum Flow Capacity, c1 (vehicles per hours)			
Design Standard For:	LOS D	LOS C	LOS B	LOS A
Straight lane or drive rarnp[2]				
One-way	1850	1853	1855	1858
Two-way	1845	1848	1850	1853
Circular Helix				
Single-Threaded	1169	1473	1631	1715
Double-Threaded	1589	1704	1761	1793
Turning bays[3]	936	1097	1233	1345
Design flow capacity[4]	NR	0.8	0.7	0.6

[1] Dimensions for each LOS per Table 3-4, capacity equation per TRRL 1969.

[2] Roadways and express ramps without parking.

[3] Turning radii per Table 3-3; no parking on end bay; no merging traffic.

[4] Ratio of expected flow rate to theoretical capacity, v/c.

NR, Not recommended.

Table 10 Functional System Capacities

(Source: Chrest, et al,. Parking structures, 2001, pg. 93).

$N_{LOS\ C}$

	Use:	Sp. Event		Retail		Office		Airport	
	PHF:	0.85		0.85		0.85		0.85	
Arrival/Departure	Rate:	85% - 0%		60%-60%		60%-5%		30%-30%	
	Angle:	70	90	70	90	70	90	70	90
Two-bay systems									
Single-threaded helix		N.A.	335	N.A.	420	N.A.	750	N.A.	840
Double-threaded helix		585	675	980	840	1360	1505	1960	1675
End-to end helix		585	675	980	840	1360	1505	1960	1675
Split level		480	335	670	420	1090	750	1345	840
Three-bay systems									
Interlocking helix		545	505	850	625	1255	1125	1695	1250
Double-threaded helix		635	830	1160	1135	1490	1880	2325	2275
Side-by-side helix		480	410	710	560	1100	930	1425	1125
Four-bay systems									
Side-by-side helix		585	675	980	840	1360	1505	1960	1675
Single-threaded helix		585	465	980	680	1360	1065	1960	1360
Double-threaded helix		655	930	1275	1360	1555	2125	2545	2720
Larger systems									
5 Bays, Single-threaded helix		615	505	1080	775	1430	1160	2160	1555
5 Bays, Double-threaded helix		675	1010	1335	1550	1600	2320	2710	3110
6 Bays, Single-threaded helix		635	535	1160	865	1485	1270	2325	1730
6 Bays, Double-threaded helix		690	1070	1415	1730	1635	2540	2835	3460

Table 11 Project Cost Estimate

(Source: Chrest, et al,. Parking structures, 2001, pg. 19).

Land Cost		**Construction Cost**		
Acquisition	$	General Conditions		$
Closing Costs	$	Site Work		$
Special Assessments	$	Concrete		$
Demolition	$	Precast Concrete		$
Off-Site Improvements	$	Masonry		$
Environmental Remediation	$	Moisture Protection		$
Subtotal	$	Enclosed Spaces		$
Design Cost		Finishes		$
Prime Design Contract	$	Specialities		$
Specialty Consultants	$	Equipment		$
Zoning	$	Elevators		$
Code	$	Mechanical		$
Landscaping	$	Electrical		$
Interior Design	$	**Subtotal**		$
Elevator/Escalator	$	**Contingencies** [a]		
Traffic	$	Schematic	5%	$
Security	$	Design Development	5%	$
Graphics	$	Bid Contingency	5%	$
Surveys	$	Construction Contingency		$
Geotechnical Investigation	$	Owner Changes	2%	$
Environmental Assessment	$	Design Changes	2%	$
Field Representative	$	Other	1%	$
Testing Services	$	**Subtotal**		$
Subtotal	$	**Total Construction Budget**		$
		Other Owner Cost		
Development Cost		Owner's Agent/Rep		$
Parking Studies	$	Construction Manager		$
Legal	$	Fixtures and Equipment		$
Financial	$	**Subtotal**		$
Administrative	$			
Insurance	$	**SUMMARY**		
Development Consultants	$	**Land Cost**		$
Pre-Development Fees	$	**Design Cost**		$
Historic Preservation	$	**Development Cost**		$
Utilities, Taxes	$	**Construction Budget**		$
Relocation	$	**Other Owner Costs**		$
Subtotal	$	**TOTAL PROJECT COST**		$

[a] As phases are complete, that portion od the contingency budget is deleted from the estimate.

Table 12 Construction Cost Estimate Breakdown

(Source: Chrest, et al,. Parking structures, 2001, pg. 20).

1000	**General Conditions**	$
0100	Bond	$
0110	Insurance	$
0120	Building Permit	$
0130	Mob/Overhead/Sup	$
2000	Gen Contr Fee	$
	Subtotal	$
02000	**Site Work**	
02060	Demolition	$
20110	Site cleaning	$
02200	Exc. Common	$
02250	Fill Granular	$
02260	Shoring	$
02300	Foundations	$
02511	Asphalt paving	$
02521	Cufl~	$
02522	Concrete Driveways/Roads	$
02523	Walks	$
02700	Storm Water Retention	$
02810	Irrigation	$
02831	Fencing	$
02900	Landscaping	$
	Subtotal	$
03000	**Concrete**	
03301	Slab-on-Grade	$
03303	Retaining Walls	$
03304	Bumper Walls, Ext	$
03304	Bumper Walls. Int	$
03305	Curbs	$
03306	Pour Strips & Washes	$
03307	Bollards	$
03370	P/T Beams, Cols, Slab	$
03371	Ramps	$
03373	Occ Space P/T Slab etc.	$
	Subtotal	$
03400	**Precast Concrete**	
03410	Structural Precast	$
03450	Arch'l Precast	$
04000	Masonry	$
04220	Brick	$
04230	Block (Fire Wall)	$
	Subtotal	$
05500	**Metals**	
05550	Arch'l Grillage	$
05521	Piperails	$
05600	Cables	$
	Subtotal	$
07000	**Moisture Protection**	
07570	Sealers	$
07910	Expansion Joints	$
07920	Caulk and Sealers	$
07930	Traffic Topping	$
	Subtotal	$
08000	**Enclosed Spaces**	
08100	Stairs	$
08110	Tower-Stair/Elevator	$
08300	Rolling Grilles	$
08400	Offices	$
08500	Storage Rooms	$
08600	Mech/Elec Rooms	$
08700	Retail Areas	$
	Subtotal	$
09000	**Finishes**	
09920	Floor Striping	$
09950	Paint/Stain Bms & Clg	$
	Sack & Paint Arch Concrete	$
09990	Misc. Painting	$
	Subtotal	$
10000	**Specialties**	
10440	Signs	$
10500	Louvers/Sound Walls	$
	Subtotal	$
11000	**Equipment**	
11150	PARCS	$
	Subtotal	$
14000	**Elevators**	
14200	Elevators	$
	Escalators	$
	Subtotal	$
15000	**Mechanical**	
15200	General Plumbing	$
15300	Standpipes	$
15300	Sprinklers-Parking	$
15510	Ventilation-Parking	$
15520	Occupied Space Plumbing	$
	Occupied Space HVAC	$
	Subtotal	$
16000	**Electrical**	
16100	Electrical System	$
16200	Occupied Space	$
	Emergency Generator	$
	Transformer	$
16800	Security System	$
	Subtotal	$

Table 13 Construction Cost per Parking Space

(Source: Walker Parking Consultants, January, 2007).

	Sq Ft/Space	270.6	297.7	324.7	351.8	378.8	405.9	433.0
	Sq M/Space	**25.0**	**27.5**	**30.0**	**32.5**	**35.0**	**37.5**	**40.0**
Cost/Sq Ft	**Cost/Sq M**							
Surface Lots								
$ 9.24	$ 100	$ 2,500	$ 2,750	$ 3,000	$ 3,250	$ 3,500	$ 3,750	$ 4,000
$ 11.55	$ 125	$ 3,125	$ 3,438	$ 3,750	$ 4,063	$ 4,375	$ 4,688	$ 5,000
$ 13.86	$ 150	$ 3,750	$ 4,125	$ 4,500	$ 4,875	$ 5,250	$ 5,625	$ 6,000
Above Grade Structures								
$ 34.64	$ 375	$ 9,375	$ 10,313	$ 11,250	$ 12,188	$ 13,125	$ 14,063	$ 15,000
$ 36.95	$ 400	$ 10,000	$ 11,000	$ 12,000	$ 13,000	$ 14,000	$ 15,000	$ 16,000
$ 39.26	$ 425	$ 10,625	$ 11,688	$ 12,750	$ 13,813	$ 14,875	$ 15,938	$ 17,000
$ 41.57	$ 450	$ 11,250	$ 12,375	$ 13,500	$ 14,625	$ 15,750	$ 16,875	$ 18,000
$ 43.88	$ 475	$ 11,875	$ 13,063	$ 14,250	$ 15,438	$ 16,625	$ 17,813	$ 19,000
$ 46.19	$ 500	$ 12,500	$ 13,750	$ 15,000	$ 16,250	$ 17,500	$ 18,750	$ 20,000
Below Grade Structures								
$ 46.19	$ 500	$ 12,500	$ 13,750	$ 15,000	$ 16,250	$ 17,500	$ 18,750	$ 20,000
$ 55.43	$ 600	$ 15,000	$ 16,500	$ 18,000	$ 19,500	$ 21,000	$ 22,500	$ 24,000
$ 64.67	$ 700	$ 17,500	$ 19,250	$ 21,000	$ 22,750	$ 24,500	$ 26,250	$ 28,000
$ 73.91	$ 800	$ 20,000	$ 22,000	$ 24,000	$ 26,000	$ 28,000	$ 30,000	$ 32,000
$ 83.15	$ 900	$ 22,500	$ 24,750	$ 27,000	$ 29,250	$ 31,500	$ 33,750	$ 36,000
$ 92.39	$ 1,000	$ 25,000	$ 27,500	$ 30,000	$ 32,500	$ 35,000	$ 37,500	$ 40,000

Table 14 Operating Expenses for Parking Structures

(Source: Walker Parking Consultants, January, 2007).

	Parking Structures		Surface Lots	
Expense Category	**MedianCost /Space/Year**	**Rec Budget* /Space/Year**	**MedianCost /Space/Year**	**Rec Budget* /Space/Year**
Cashiering and Management	$ 309	$ 309	$ 62	$ 62
PARCS Replacement **	$ -	$ 31	$ -	$ 21
Total Cost Of Revenue Collection	$ 309	$ 340	$ 62	$ 83
Security	$ 110	$ 110	$ 47	$ 47
Subtotal	$ 419	$ 450	$ 109	$ 130
Basic Operating Expense				
Utilities	$ 54	$ 54	$ 29	$ 29
Routine Maintenance	$ 50	$ 55	$ 8	$ 8
Preventative Maintenance**	$ 20	$ 36	$ -	$ 5
Uniforms, Supplies	$ 19	$ 19	$ 5	$ 5
Insurance	$ 19	$ 19	$ 5	$ 5
Miscellaneous	$ 15	$ 15	$ 2	$ 2
Subtotal Basic Operating Expense	$ 177	$ 198	$ 49	$ 54
Snow Removal	$ 8	$ 8	$ 3	$ 16
TOTAL	$ 604	$ 656	$ 161	$ 200
Sample Size:	156 facilities		73 facilities	

* Includes recommended maintenance and replacement budgets

** Sinking fund contribution for future periodic repair/replacement

Figures stated in 2006 dollars

Source: Operating Expense Survey, Walker Parking Consultants, 2003 and 2005

Table 15 Monthly Revenue Required per Space

(Source: Walker Parking Consultants, January, 2007).

Const Cost /Space	Annual Operating Cost Per Space: $ 50	$ 100	$ 150	$ 200	$ 250	$ 300	$ 400	$ 500	$ 600	$ 700	800	900	1000
$ 1,000	$ 14	$ 18	$ 22	$ 26	$ 31	$ 35	$ 43	$ 51	$ 60	$ 68	$ 76	$ 85	$ 93
$ 2,000	$ 24	$ 28	$ 32	**$ 36**	$ 40	$ 45	$ 53	$ 61	$ 70	$ 78	$ 86	$ 95	$ 103
$ 3,000	$ 34	$ 38	$ 42	**$ 46**	$ 50	$ 54	$ 63	$ 71	$ 79	$ 88	$ 96	$ 104	$ 113
$ 4,000	$ 43	$ 48	$ 52	**$ 56**	$ 60	$ 64	$ 73	$ 81	$ 89	$ 98	$ 106	$ 114	$ 123
$ 5,000	$ 53	$ 57	$ 62	$ 66	$ 70	$ 74	$ 82	$ 91	$ 99	$ 107	$ 116	$ 124	$ 132
$ 6,000	$ 63	$ 67	$ 71	$ 76	$ 80	$ 84	$ 92	$ 101	$ 109	$ 117	$ 126	$ 134	$ 142
$ 7,000	$ 73	$ 77	$ 81	$ 85	$ 90	$ 94	$ 102	$ 110	$ 119	$ 127	$ 135	$ 144	$ 152
$ 8,000	$ 83	$ 87	$ 91	$ 95	$ 99	$ 104	$ 112	$ 120	$ 129	$ 137	$ 145	$ 154	$ 162
$ 9,000	$ 93	$ 97	$ 101	$ 105	$ 109	$ 113	$ 122	$ 130	$ 138	$ 147	$ 155	$ 163	$ 172
$ 10,000	$ 102	$ 107	$ 111	$ 115	$ 119	$ 123	$ 132	$ 140	**$ 148**	**$ 157**	$ 165	$ 173	$ 182
$ 12,500	$ 127	$ 131	$ 135	$ 140	$ 144	$ 148	$ 156	$ 165	**$ 173**	**$ 181**	$ 190	$ 198	$ 206
$ 15,000	$ 152	$ 156	$ 160	$ 164	$ 168	$ 172	$ 181	$ 189	**$ 197**	**$ 206**	$ 214	$ 222	$ 231
$ 17,500	$ 176	$ 180	$ 185	$ 189	$ 193	$ 197	$ 205	$ 214	**$ 222**	**$ 230**	$ 239	$ 247	$ 255
$ 20,000	$ 201	$ 205	$ 209	$ 213	$ 217	$ 222	$ 230	$ 238	$ 247	$ 255	$ 263	$ 272	$ 280
$ 22,500	$ 225	$ 230	$ 234	$ 238	$ 242	$ 246	$ 255	$ 263	$ 271	$ 280	$ 288	$ 296	$ 305
$ 25,000	$ 250	$ 254	$ 258	$ 262	$ 267	$ 271	$ 279	$ 287	$ 296	$ 304	$ 312	$ 321	$ 329
$ 27,500	$ 275	$ 279	$ 283	$ 287	$ 291	$ 295	$ 304	$ 312	$ 320	**$ 329**	**$ 337**	$ 345	$ 354
$ 30,000	$ 299	$ 303	$ 307	$ 312	$ 316	$ 320	$ 328	$ 337	$ 345	**$ 353**	**$ 362**	$ 370	$ 378
$ 32,500	$ 324	$ 328	$ 332	$ 336	$ 340	$ 345	$ 353	$ 361	$ 370	**$ 378**	**$ 386**	$ 395	$ 403
$ 35,000	$ 348	$ 352	$ 357	$ 361	$ 365	$ 369	$ 377	$ 386	$ 394	**$ 402**	**$ 411**	$ 419	$ 427
$ 37,500	$ 373	$ 377	$ 381	$ 385	$ 390	$ 394	$ 402	$ 410	$ 419	**$ 427**	**$ 435**	$ 444	$ 452
$ 40,000	$ 397	$ 402	$ 406	$ 410	$ 414	$ 418	$ 427	$ 435	$ 443	**$ 452**	**$ 460**	$ 468	$ 477
$ 42,500	$ 422	$ 426	$ 430	$ 435	$ 439	$ 443	$ 451	$ 460	$ 468	$ 476	$ 485	$ 493	$ 501
$ 45,000	$ 447	$ 451	$ 455	$ 459	$ 463	$ 467	$ 476	$ 484	$ 492	$ 501	$ 509	$ 517	$ 526
$ 47,500	$ 471	$ 475	$ 480	$ 484	$ 488	$ 492	$ 500	$ 509	$ 517	$ 525	$ 534	$ 542	$ 550
$ 50,000	$ 496	$ 500	$ 504	$ 508	$ 512	$ 517	$ 525	$ 533	$ 542	$ 550	$ 558	$ 567	$ 575

Interest Rate = 7%

$36-$56 Required Revenue per Month for Typical Surface Lot

$148-$230 Required Revenue per Month for Typical Above Grade Parking Structure

$329-460 Required Revenue per Month for Typical Underground Parking Structure

Required Monthly Revenue Per Space			**$ 25**	**$ 50**	$ 75	$ 100	**$ 150**	**$ 200**	**$ 250**	$ 300	**$ 350**	**$ 400**	**$ 450**
Hourly Rate Required:	turns/day	days/yr											
Weekday revenue only	2	250	**$ 0.30**	**$ 0.60**	$ 0.90	$ 1.20	**$ 1.80**	**$ 2.40**	**$ 3.00**	$ 3.60	**$ 4.20**	**$ 4.80**	**$ 5.40**
	3	250	**$ 0.20**	**$ 0.40**	$ 0.60	$ 0.80	**$ 1.20**	**$ 1.60**	**$ 2.00**	$ 2.40	**$ 2.80**	**$ 3.20**	**$ 3.60**
Weekday and Saturdays	2	300	**$ 0.25**	**$ 0.50**	$ 0.75	$ 1.00	**$ 1.50**	**$ 2.00**	**$ 2.50**	$ 3.00	**$ 3.50**	**$ 4.00**	**$ 4.50**
	3	300	**$ 0.17**	**$ 0.33**	$ 0.50	$ 0.67	**$ 1.00**	**$ 1.33**	**$ 1.67**	$ 2.00	**$ 2.33**	**$ 2.67**	**$ 3.00**
7 days a week	2	360	**$ 0.21**	**$ 0.42**	$ 0.63	$ 0.83	**$ 1.25**	**$ 1.67**	**$ 2.08**	$ 2.50	**$ 2.92**	**$ 3.33**	**$ 3.75**
	3	360	**$ 0.14**	**$ 0.28**	$ 0.42	$ 0.56	**$ 0.83**	**$ 1.11**	**$ 1.39**	$ 1.67	**$ 1.94**	**$ 2.22**	**$ 2.50**
			Typical Surface Lot				Typical Above Grade Structure				Typical Below Grade Structure		

Average Stay for all cases: 2 hours

Table 16 Daily Maintenance Checklist

(Source: Chrest, et al,. Parking structures, 2001, pg. 633).

MAINTENANCE MANUAL AND PROGRAM	**Inspector________**
DAILY OPERATIONAL CHECKLIST	**Date____________**
PARKING STRUCTURE NAME	
Owner	
City, State	

CLEANING

- Pick up trash
- Sweep elevator tower
- Sweep stair tower
- Sweep office and collection booth
- Wash away parking areas required to remove odors
- Remove graffiti

SNOW PLOW REMOVAL AND ICE CONTROL

- Remove snow
- Apply sand or deicer

DRAINAGE

- Clean off floor drain grates - all levels
- Squeegee ponded water to nearest drain - all levels

INSPECTION

- Check for trip hazards and other safety concerns

NOTES AND CORRECTIVE ACTION NEEDED:________________________

____

Table 17 Monthly Maintenance Checklist

(Source: Chrest, et al,. Parking structures, 2001, pg. 634).

MAINTENANCE MANUAL AND PROGRAM **Inspector____**
MONTHLY OPERATIONAL CHECKLIST **Date ________**
PARKING STRUCTURE NAME
Owner
City, State

MECHANICAL EQUIPMENT

ELEVATORS
- Normal operation of elevators
- Clean door tracks at each level and in cab
- Maintenance performed per service contract

HVAC SYSTEM
- Normal operation of entire system
- Change air filters
- Normal operation of fans

FIRE PROTECTION EQUIPMENT
- Check standpipes for operation
- Check charge on portable fire extinguishers
- Normal operation of smoke and heat detectors

NOTES AND CORRECTIVE ACTION NEEDED:__________________

Table 18 **Semi-annual Maintenance Checklist**

(Source: Chrest, et al,. Parking structures, 2001, pg. 635).

MAINTENANCE MANUAL AND PROGRAM **Inspector_______**
SEMI-ANNUAL OPERATIONAL CHECKLIST **Date___________**
PARKING STRUCTURE NAME
Owner
City, State

ELECTRICAL SYSTEM

- Control and power panels for proper operation
- Timers and photocells for proper operation
- Ground fault circuit interrupters for operation

MECHANICAL EQUIPMENT

FIRE PROTECTION EQUIPMENT

- Test sprinklers for proper operation

GRAPHICS AND FLOOR STRIPING

- Clean signs
- Directional signs
- Entrance/exit signs
- Tier/level designations
- Examine paint or facing material for deterioration
- Floor striping and graphics

NOTES AND CORRECTIVE ACTION NEEDED:________________________
____

Table 19 **Annual Maintenance Checklist**

(Source: Chrest, et al,. Parking structures, 2001, pg. 636).

MAINTENANCE MANUAL AND PROGRAM **Inspector_________**
ANNUAL OPERATIONAL CHECKLIST **Date_____________**
PARKING STRUCTURE NAME
Owner
City, State

ELECTRICAL SYSTEM
- Distribution panels
- Electrical conduit

CLEANING
- Prune trees

WINTERIZATION
- Washdown
- Flush
  - Standpipes
  - Sprinklers
  - Hosebibs
  - Drains
  - Piping
- Check for blockages

OVERALL
- General review of all operational components

NOTES AND CORRECTIVE ACTION NEEDED:______________________________

____

Table 20 Annual Maintenance Cost (New Facility)

(Source: Chrest, et al,. Parking structures, 2001, pg. 639).

		Construction Cast-in-place		Age 0	Cars 1000	SF 320,000
Item Description	Quantity	Unit Price	Total Cost	Time	$/car/Yr	$/SF/Yr
Preventive Maintenance						
Sealants Floor Slab	10,000	3.00		10	3	0.01
Architectural Sealants	2,600	3.50	9,000	12	1	0.00
Expansion Joints	96	80.00	8,000	10	1	0.00
Penetrating Sealer	256,000	0.50	128,000	5	26	0.08
Traffic Topping	–	225	–	15	0	0.00
Supplemental Drains & Piping	–	180,000	–	25	0	0.00
Miscellaneous	–		–			
Subtotal			**175,000**		**$31.00**	**$0.09**
Replacement Maintenance						
Replace Drainage System	320,000	0.65	208,000	25	8	0.03
Replace Lighting System	320,000	1.75	560,000	25	22	0.07
Replace Parking Revenue Control	320,000	0.32	102,000	6	17	0.05
Replace Signage	1	30,000	30,000	25	1	0.00
Replace Elevators	2	120,000	240,000	25	10	0.03
Miscellaneous			–			
Subtotal			**1,140,000**		**$58.00**	**$0.18**
Routine Maintenance						
Maintain Joint Sealants	1	1,500	2,000	1	2	0.01
Maintain Traffic Topping			–	1	0	0.00
Interim Slab Patching			–		0	0.00
Interim Beam & Column Patching			–		0	0.00
Stairtower Maintenance	1	2,000	2,000	1	2	0.01
Maintain Drainage System	1	1,000	1,000	1	1	0.00
Maintain Lighting	1	6,000	6,000	1	6	0.02
Maintain Parking/Revenue Control	1	2,000	2,000	1	2	0.01
Annual Inspections	1	5,000	5,000	3	2	0.01
Maintain Elevators	12	500	6,000	1	6	0.02
Miscellaneous	1	2,000	2,000	1	2	0.01
Sweeping/Cleaning	12	1,000	12,000	1	12	0.04
Power Wash Floors	4	2,000	8,000	1	8	0.03
Painting	1	10,000	10,000	1	10	0.03
Subtotal			**56,000**		**$53.00**	**$0.19**
Average Annual Maintenance Cost					**$142.00**	**$0.46**

Table 21 Annual Maintenance Cost (20 Year Old Facility)

(Source: Chrest, et al,. Parking structures, 2001, pg. 640).

		Construction		Age	Cars	SF
		Cast-in-place		20	1000	320,000
Item Description	Quantity	Unit Price	Total Cost	Time	$/car/Yr	$/SF/Yr
Preventive Maintenance						
Sealants Floor Slab	10,000	3.00	30,000	10	3	0.01
Architectural Sealants	2,600	3.50	9,000	12	1	0.00
Expansion Joints	96	80.00	8,000	10	1	0.00
Penetrating Sealer	–	0.50	–	5	0	0.00
Traffic Topping	256,000	2.25	576,000	15	38	0.12
Supplemental Drains & Piping	10	1800.00	18,000	25	1	0.00
Miscellaneous	1	50,000	50,000	10	5	0.02
Subtotal					**$49.00**	**$0.15**
Replacement Maintenance						
Replace Drainage System	320,000	0.65	208,000	25	8	0.03
Replace Lighting System	320,000	1.75	560,000	25	22	0.07
Replace Parking Revenue Control	320,000	0.32	102,000	6	17	0.05
Replace Signage	1	30,000	30,000	25	1	0.00
Replace Elevators	2	120,000	240,000	25	10	0.03
Miscellaneous			–			
Subtotal					**$58.00**	**$0.18**
Routine Maintenance						
Maintain Joint Sealants	1	1,500	2,000	1	2	0.01
Maintain Traffic Topping	1	2,000	2,000	1	2	0.01
Interim Slab Patching	1	3,000	3,000	1	3	0.01
Interim Beam & Column Patching	1	2,000	2,000	1	2	0.01
Stairtower Maintenance	1	2,000	2,000	1	2	0.01
Maintain Drainage System	1	1,000	1,000	1	1	0.00
Maintain Lighting	1	6,000	6,000	1	6	0.02
Maintain Parking/Revenue Control	1	2,000	2,000	1	2	0.01
Annual Inspections	1	7,000	7,000	1	7	0.02
Maintain Elevators	12	1,000	12,000	1	12	0.04
Miscellaneous	1	4,000	4,000	1	4	0.01
Sweeping/Cleaning	12	1,000	12,000	1	12	0.04
Power Wash Floors	4	2,000	8,000	1	8	0.03
Painting	1	10,000	10,000	1	10	0.03
Subtotal					**$73.00**	**$0.25**
Average Annual Maintenance Cost					**$180.00**	**$0.58**

Table 22 <u>Shared Parking Calculation example</u>

(Source: BFJ, March, 2007).

Shared Parking Calculation for Downtown Saratoga Springs (60% Balanced Build-Out Scenario)

Building Use	Size	Rooms/ DUs	Peak Parking		Weekday AM (10-11 AM)		Weekday Lunch (12-2 PM)		Weekday PM (3-4 PM)		Weekday Evening (7-8 PM)		Saturday Midday (12-2 PM)	
	1000 s.f.		Ratio	Spaces	% Pres[4]	Cars	% Pres[4]	Cars	% Pres[4]	Cars	% Pres[4]	Cars	% Pres[4]	Cars
Retail	85.9		2.5	215	60%	129	85%	183	80%	172	80%	172	100%	215
Restaurant	25.7		5.0	129	30%	39	70%	90	50%	64	80%	103	50%	64
Office	197.3		2.5	493	100%	493	97%	478	93%	459	5%	25	17%	84
Residential[2]	2,820.3	1,410	1.5	2,115	50%	1,058	50%	1,058	50%	1,058	90%	1,904	75%	1,586
Institutional	12.6		3.0	38	20%	8	50%	19	80%	30	50%	19	100%	38
Hotel[3]	44.0	44	0.9	40	83%	33	30%	12	68%	27	90%	36	40%	16
Total	**3,185.8**			**3,029**		**1,759**		**1,839**		**1,810**		**2,258**		**2,003**

Notes:

1. The peak parking ratio typically corresponds to the zoning requirement and represents the amount of parking that would have to be supplied if each use was built independently on its own lot.

2. Assuming the average residentail dwelling unit of 2,000 square feet/2bedrooms.
3. Assuming an average of 1000 square feet floor area per hotel room

4. The percentages for the presence of each peak parking demand by time period are based on "Shared Parking" by the Urban Land Institute 1983, "Parking Generation" 3rd Edition, Institute of Transportation Engineers, 2004, and on BFJ experience.

Table 23 **Entry and Exit ratios**

(Source: Weant and Levinson, Parking, 1990).

Table 9-1. Typical Peak-hour Volumes as a Percentage of the Total Parking Spaces

Type of Activity	*AM Peak Hour*		*PM Peak Hour*	
	In	*Out*	*In*	*Out*
Hotel-motel	30-50	30-50	30-60	10- 30
Residential	5-10	30-50	30-50	10- 30
Office	40-70	5-15	5-20	40- 70
Medical office	40-60	10-20	10-30	60- 80
Hospital				
Visitor	30-40	40-50	40-60	50- 75
Employee	60-75	5-10	10-15	60- 75
Retail-commercial	10-30	10-20	30-60	40- 65
Central business district	40-60	10-20	10-30	40- 60
Airport-All	40-65	30-50	70-90	70- 90
Short-term (0-3 hours)	50-75	80-100	90-100	90-100
Mid-term (4-24 hours)	10-30	5-10	10-30	10- 30
Long-term (more than 24 hours)	5-10	5-10	5-10	5- 10
	Before event — (In)		After event — (out)	
Special events	80-100		85-200[a]	

a. Maximum assumes a 30-minute departure.

Source: Adapted from: Robert W. Crommelin, "Entrance-Exit Design and Control for Major Parking Facilities," a seminar presentation (Encino, CA: Robert Crommelin and Associates, Inc., 1972), and Anthony P. Chest, Mary S. Smith, Sam Bhuyan, *Parking Structures Planning, Design, Construction, Maintenance and Repair*, (*Van Nostrand Reinhold*, New York: 1989).

GLOSSARY

(Source: Walker Parking Consultants, 2007).

LEVEL OF SERVICE (LOS): A qualitative measure of the conditions in a particular functional component, as applied to many design parameters in a parking facility.

MODULE: The out-to-out dimension of rows of parking stalls and the drive aisle providing access thereto.

ANGLED PARKING: Stalls designed at an angle less than 90 degrees/perpendicular to the module edge.

PARKING BAY: An area comprising a drive aisle and the adjacent parking stalls.
(SINGLE LOADED): Only one row of parking served by the aisle.
(DOUBLE LOADED): Parking on both sides of the aisle.

TURNING BAY: the area at the end of parking facilities used to turn from one parking bay to another.

END BAY PARKING: Parking stalls at the ends of the parking facility that park or unpark from the turning bay.

PARKING RAMP: A ramp from floor to floor with parking on it.

EXPRESS RAMP: A ramp dedicated to moving vehicles vertically from floor to floor with no parking on the slope. An express ramp typically has a greater degree of slope compared to a parking ramp.

CASCADING (EXPRESS) RAMP: An express ramp that continues in a straight line from floor to floor.

STACKED (EXPRESS) RAMPS: A system with express ramps between floors, stacked over each other and thus requiring circulation through the floor to get to the next express ramp.

SLIP (EXPRESS) RAMPS: one-way ramps displacing a row of parking stalls.

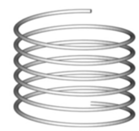
END (STACKED) RAMPS: Stacked ramps at one end of the deck, perpendicular to the long parking aisles. In other cases, the ramps are parallel to the long parking aisles.

SPLIT LEVEL: A system of “trays” of two parking bays, each one half tier above the other, accessed by short stacked ramps.

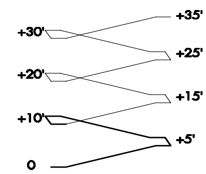
CIRCULAR HELIX: An express ramp in a circular shape; can be either single or double threaded.

HELIX: A coiled shape or spiral. In a parking structure, a series of sloped parking bays and/or express ramps that provide floor-to-floor circulation.

"SINGLE THREAD" HELIX: A helix that rises one floor (typically 10 to 12 feet) with each 360 degrees of revolution. In decks at least 200 ft long, one bay may slope with all other bays flat. In shorter decks, two bays must slope, per diagram at right.

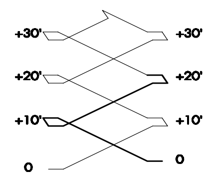


A HELIX



SINGLE THREAD HELIX

"DOUBLE THREAD" HELIX: A helix that rises two floors or levels with each 360 degrees of revolution. Two threads are thus intertwined in the same footprint.



DOUBLE THREAD HELIX

SIDE-BY-SIDE HELIX: A variation of a single-threaded circulation system consisting of two single threaded circulation systems "side by side". In a three-bay deck, the middle bay slopes and has two way traffic with one lane being part of the upbound path and the other the downbound path. The outer flat bays may have angled or 90 degree parking. In four bay decks with angled parking and one way traffic, the two middle bays slope and up traffic is completely separated from downbown paths. On occasion, two double threaded helixes may be provided side by side.

END-TO-END HELIX: A circulation system comprised of two single or double threaded helixes "end to end."

INTERLOCKED HELIX: A variation of a single-threaded circulation system for a three-bay deck whereby separate one-way parking ramps are provided between floors, but they share use of a third flat bay on each floor.

HINGE POINT: The point at which the ramp starts or ends.

TRANSITION SLOPE: A segment at the start or end of a ramp provided to soften the change in slope, preventing bottoming out of vehicles; required if the differential slope between the floor and the ramp exceeds 10.0%. Transition slopes should generally be half the slope of the differential slope.

LONG SPAN: a structural system with columns only at the edges of parking modules, rather than between parked cars. Long span construction typically is deeper than short span construction with 30 to 36" overall structural depths common. 2 to 4" additional clearance is generally required for vehicular clearance; therefore floor to floor heights generally are 10' to10'6 for minimum 7' vehicular clearance, and 11' to 11'6" for the 8'2" clearance for vans accessible stalls per ADAAG. Lights and signs are placed on beam faces or tee stems.

SHORT SPAN: a structural system with columns between parked vehicles; most common is a 30' by 30' bay with three 90 degree stalls between columns. Structural depth may be less than 1', but to allow for suspended lights and signs, typically, 9' floor to floor is required for 7' vehicular clearance, with 10' required for van accessible stalls. Short span structures are often not prestressed and thus may be cheaper on a cost per sq ft basis, but efficiency is lost to columns between stalls, and the durability is significantly lower. Generally, short span construction is only used when the parking is under a building requiring more columns.

PRECAST CONCRETE: a structural system, usually long span, with all members made in a plant, trucked to the site and then erected. The floor slab is composed of precast concrete "double tees" which are shaped like this: TT Depending on the region and local manufacturers, most tees today are 12' wide by the module dimension (50 to 60' long), although some are 15' or 10'. The tees are generally prestressed with tensioned cables placed in the forms and then concrete is cast around them. When the tension devices are released, the members already have compression forces to counter service loads, reducing the natural cracking of concrete members. With precast concrete structures, the columns in the longitudinal dimension are nearly always some multiple of the tee width, with three tees between column grids most common and most economical. Precast is often more economical in many markets, except in high seismic zones, such as California.

POST-TENSIONED (P/T) CONCRETE: a structural system with concrete entirely "cast-in-place" in the permanent position. Members have cables cast in to the concrete which are tensioned after the concrete sets, creating the same prestressing effects in precast tees that reduce cracking and thus improve durability.

Appendix A: NJ Precedents

For the purpose of establishing a baseline, the following six case studies identify precedents for study, of structured parking projects initiated in New Jersey. They provide a comprehensive palette illustrating many useful dynamics. The projects demonstrate varying positions on several important spectrums:

- stand alone parking structure vs. integrated mixed use

- adjacency to transit vs. location in CBD away from transit

- primary goal to solve commuter parking issues vs. other parking issues

- "successful" community process vs. unsuccessful

- size: 500 spaces – 1200 spaces

The precedents that follow include:

1). Spring Street Garage, Princeton, NJ

2) Transportation Center Garage, Rahway, NJ

3) Redevelopment Project, Westfield, NJ

4) Broad Street Garage, Summit, NJ

5) Transit Village Garage, Morristown, NJ

6) Ferren Deck and Mall, New Brunswick, NJ

SPRING STREET GARAGE
PRINCETON, NJ

Impetus/Problem to be addressed: Princeton Borough and Township jointly determined that a substantial expansion and reconstruction of the library was necessary and desirable. Studies concluded that maintaining the library in its existing location was preferred to relocating it out of the town center. The priority was to maintain its pedestrian friendliness. The Borough's contribution was to provide enhanced parking on what had been an adjacent surface parking lot.

Adjacency to Transit: No

Community Process: Visionary mayor, cooperative and supportive council, significant community input invited, successful articulation of benefits.

Capacity: 500 spaces
Owner: Borough of Princeton
Date Built: 2004
Mixed Uses: 12.3K sf ground level retail, 77 residential units, Park/Plaza

Usage: Library patrons
Residents
CBD customers

Permitting/Pricing: Parking free to Library patrons

Payment Systems: Pay-on-foot

Finances:

Construction Cost:	$ 9.6 M	($ 19.3K/space)
Capital Cost:	$ 11.3 M	($ 22.7K/space)
Operating Costs:		
Revenue (annual):		
Revenue sources:	incremental parking revenue, ground leases, PILOT	

SPRING STREET GARAGE
PRINCETON, NJ

View of project across plaza – library and residences to left, parking at right rear

View of project from side – plaza off screen left, parking entrance/exit at right

TRANSPORTATION CENTER GARAGE
RAHWAY, NJ

Impetus/Problem to be addressed:	Part of the Rahway Transportation Center. Developed to resolve parking shortages at the NJT station and to assist the revitalization of the CBD.
Adjacency to Transit:	Yes
Capacity:	524 spaces (300 dedicated to commuters), on six levels
Owner:	City of Rahway
Date Built:	2005
Mixed Uses:	None
Usage:	Commuter CBD customers
Permitting/Pricing:	Monthly and annual permits, $65 and $780 respectively Daily rates: to 2hr s= $1, 4hrs= $2, 5hrs = $5, 5-13 hrs = $6, $8 max
Payment Systems:	Pay-on-foot (daily), swipe cards (permit)
Finances:	

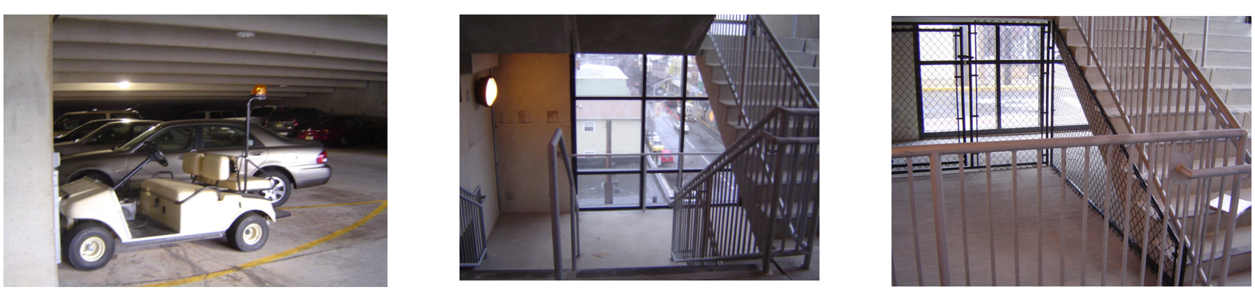
Construction Cost:	$ 7.8 M	($ 13.7K/space)
Capital Cost:	$ 8.6 M	($ 16.4K/space)
Operating Costs:		
Revenue (annual):		
Revenue sources:	advanced NJT leases, sale of develop. rights, PILOP	

TRANSPORTATION CENTER GARAGE
RAHWAY, NJ

View from Plaza

View of side

Pay-on-foot revenue control system



Security measures –foot patrol, golf cart service, emergency phones, glazed stairwells, rail guides, screening

REDEVELOPMENT PROJECT
WESTFIELD, NJ

Impetus/Problem to be addressed: Resolve general parking demand problems in Town, CBD.

Adjacency to Transit: No

Community Process: For a period of more than a decade, the Town of Westfield went through a process similar to that in the Borough of Princeton. Westfield retained parking consultants to analyze the parking demand and parking solutions within the Town. A volunteer parking committee undertook a similar study carefully analyzing parking demand and proposing certain solutions. The Mayor and governing body embraced the committee's recommendations and focused on two redevelopment projects each on a surface parking facility owned by the Town.

The Town proceeded with the designation of the areas as in need of redevelopment, relating to underused parking facilities in a downtown and went through a Request for Proposals (RFP) process. A redeveloper was selected and planning began.

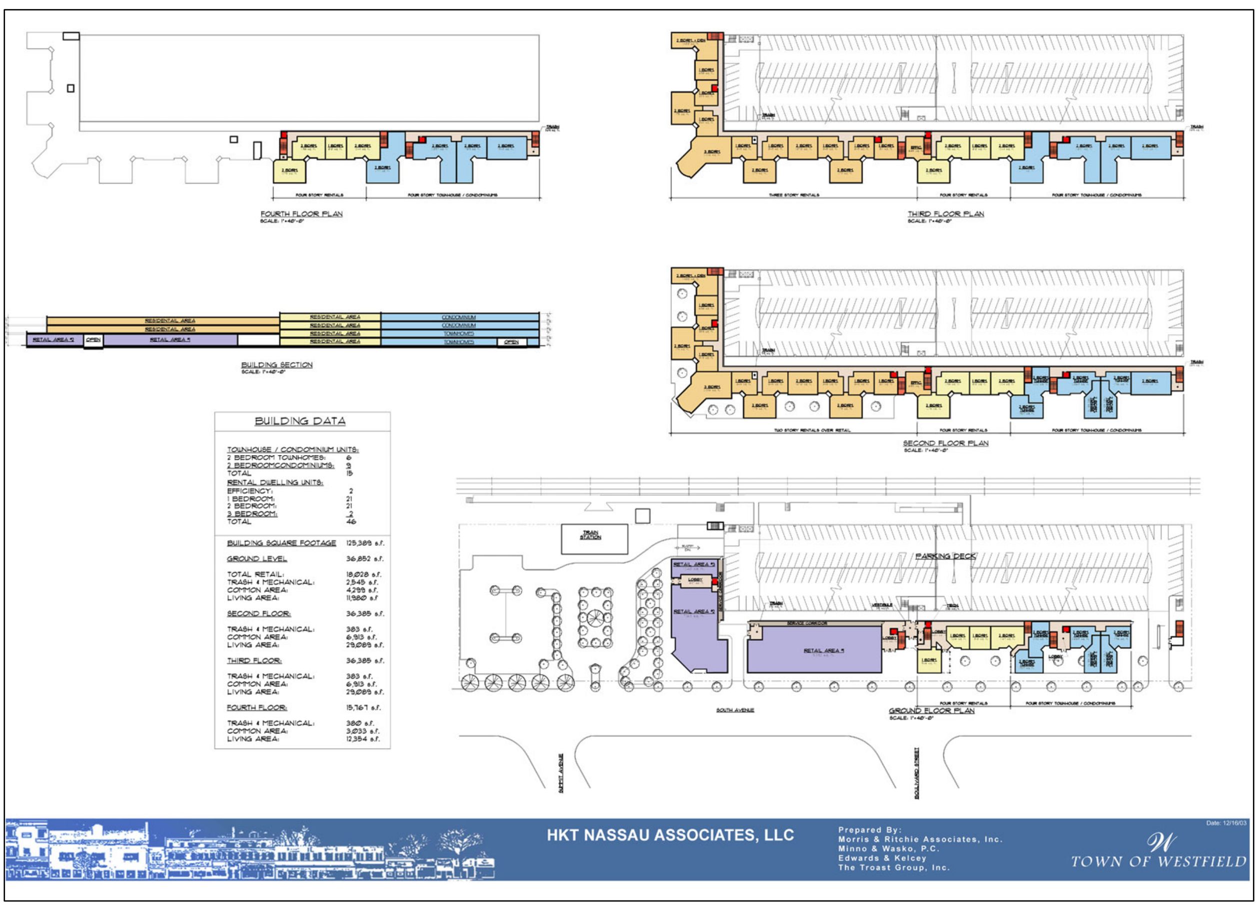
During the course of the process, the Mayor changed and in one election, one member of the governing body was replaced. In a subsequent election, additional members of the governing body were replaced. The new governing body determined to take a different course. It acquiesced in the demand for a referendum and although the Local Redevelopment and Housing Law prohibits referenda, the governing body determined to proceed with a non-binding referendum. With the difficulty of presenting a question as to how a redevelopment process should proceed, the referendum was soundly defeated and the governing body determined not to proceed with the redevelopment project.

Capacity (intended): 1200 spaces
Owner: n/a
Date Built: n/a
Mixed Uses (intended): South side project would address Westfield's residential commuter parking demand by construction of a parking structure shielded by a mixed-use structure wrapping around it including retail at grade, and three or four residential floors above.
North side project would replace surface-parking facilities with a parking structure, again, screened from two neighborhoods by retail, townhomes or condominiums on one side, and retail and residential on the other side.

Usage (intended): CBD customers, residents

REDEVELOPMENT PROJECT
WESTFIELD, NJ

Architects preliminary renderings



Preliminary plans

BROAD STREET GARAGE
SUMMIT, NJ

Impetus/Problem to be addressed: Resolve commuter parking shortage at train station.

Adjacency to Transit: Yes

Community Process: 1992 NJT proposed 600 space garage at Broad St. and Summit Ave.
Community rejected: loss of local control, size, traffic and safety issues
Town forms Parking Advisory Committee – local business people, traffic officer, traffic engineer, commuters, residents.
Recommendation – build and restrict to residents and CBD employees.

Capacity: 504 spaces (300 dedicated to commuters), on six levels
Owner: Town of Summit
Date Built: 1998
Mixed Uses: None

Usage: Commuter
CBD customers

Payment Systems: Automated

Finances:

Construction Cost:	$ 6.5 M	($ 13.0K/space)
Capital Cost:	$ 8.6 M	($ 16.4K/space)
Operating Costs:	$ 50K/yr	($100/space annually)
Revenue (annual):	$ 365K/yr	
Revenue sources:		

**BROAD STREET GARAGE
SUMMIT, NJ**

View of Summit Station with Garage Stair tower at left rear

TRANSIT VILLAGE GARAGE
MORRISTOWN, NJ

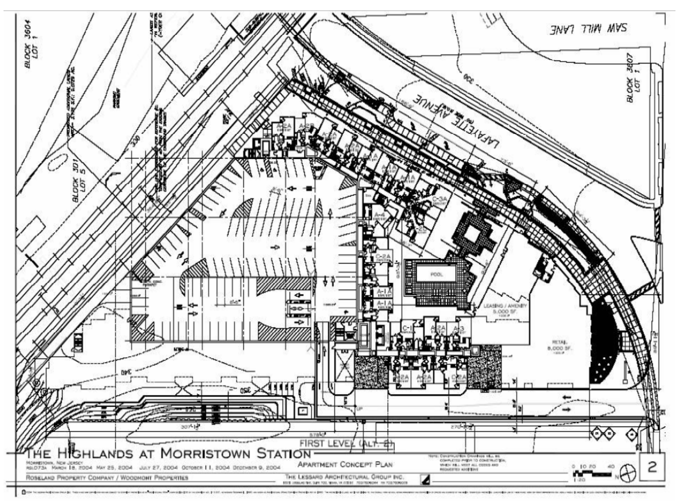
Impetus/Problem to be addressed:	Resolve commuter parking shortage at train station.
Adjacency to Transit:	Yes
Community Process:	Developers citing NJT publication *Planning for Transit Friendly Land Use* seeking parking reductions for sites in area now classified a Transit Node. Existing surface lot with 298 spaces part of 3.5 acres owned by NJT within 9 acre Transit Village Core Zone – operated by MPA. Project delays over construction phase parking – developer commits only 200 of existing 298 spaces.
Capacity:	725 spaces (415 for NJT, 271 residents only, 50 shared w/retail) (reflects PFTFLU reduction of 143 (to 1.2 spaces/unit))
Mixed Uses:	218 apartments, 8K sf retail
Usage:	commuter residents retail
Permitting/Pricing:	NJT to determine, presently $40 – 50/month
Payment Systems:	Automated pay booths at each floor
Finances:	

Construction Cost:	$	6.5 M	total project
Capital Cost:	$	8.6 M	garage only ($ 9.7K/space)
Operating Costs:			
Revenue (annual):			
Revenue sources:			

TRANSIT VILLAGE GARAGE
MORRISTOWN, NJ

Nine acre TVC zone designated 1999

Architects concept



First floor plan

Elevations

FERREN MALL AND PARKING DECK
NEW BRUNSWICK, NJ

Impetus/Problem to be addressed:	Resolve commuter parking shortage at train station and general parking shortages in CBD due to Medical Center, County Government and University demands.
Adjacency to Transit:	Yes
Capacity:	Daily Deck: 643 spaces, Monthly Deck: 585 spaces
Owner:	New Brunswick Parking Authority
Date Built:	1985
Mixed Uses:	63.8k sf retail
Usage:	Monthly: Robert Wood Johnson Medical Center personnel County personnel Commuters (15% are New Brunswick residents) Daily: Jurors Rutgers Bookstore Patrons Hospital visitors
Permitting/Pricing:	Monthly; New Brunswick. residents = \$85, non-res = \$95 15% oversell (90 spaces), 700 names on waiting list Daily: \$1.25 first two hrs, \$1/hr after 2 hrs, \$11 max Juror flat rate, shopper reimbursement Weekend parking free (7:30AM Sat – 7:30 AM Mon)
Payment Systems:	Revenue control devices
Finances:	

Construction Cost:	\$ 11.0 M (\$ 9.0K/space)
Capital Cost:	\$ 16.4 M (\$ 13.4 K/space)
Operating Costs:	\$ 450 – 500/space/year
Revenue (annual):	\$ 1.2M from 57.7K net leasable sf
Revenue sources:	ground leases

FERREN MALL AND PARKING DECK
NEW BRUNSWICK, NJ

Exterior view

Exterior view

Entrance to Retail Mall

Stairs to medical office space below

Entrance to segregated monthly use deck

staged ticketing for increased flow rate

Appendix B: Case Studies

A) SELECTION PROCESS

Four municipalities considering the development of structured parking were selected as case studies where the findings of this study could be applied and design tested in real world situations. Two of the communities have acute parking shortages at their train stations, while the other two suffer from large surface parking lots consuming valuable land in and around their central business districts. It is helpful, however, not to begin with a discussion of the differences between them, as these will become evident when discussing the communities individually, but to begin with an important attribute that all four municipalities have in common.

All four case study communities - Red Bank, Ridgewood, Metuchen, and Brick Church at East Orange,—enjoy a high level of rail service during peak commuting hours, although Brick Church's service is lower compared to the other communities. However, Brick Church has the shortest trip time to midtown Manhattan—less than a half hour. Red Bank has the longest, and trip time from Ridgewood includes a transfer at Secaucus Junction to another train, and this two-seat ride is a significant deterrent for commuters. Consequently, daily boardings at Ridgewood are lower than they would be if it were a one-seat ride. Metuchen, on the Northeast Corridor, has a much higher level of activity because of the combination of frequent trains and a one-seat ride that clocks in at less than forty-five minutes. Due to the high level of service and the presence of a large amount of surface parking, Metuchen attracts commuters from surrounding communities. Red Bank also draws a large number of out-of-town commuters. In contrast, Ridgewood and Brick Church draw mainly from residents of their respective towns. This means that fewer people drive to Ridgewood and Brick Church stations than to Red Bank and Metuchen stations. It should be noted, however, that Ridgewood and Brick Church are also much more constrained by their limited parking supplies.

BOROUGH OF RED BANK

Red Bank is distinct from the other case communities in that it has two centers, or nodes. The first node, at the intersection of Broad and Monmouth Streets, serves as Red Bank's downtown. It developed commercially as a response to the linkage between the port at the end of Wharf Avenue and the colonial Township of Shrewsbury.

The Count Basie Theater is the heart of an emerging arts district.

The second node centers on the train station and the former industrial uses that surround it.

Monmouth Street connects these nodes, and is developing as a pedestrian corridor. The ultimate vision for Red Bank is to have two balanced activity centers linked by a vibrant arts district.

Red Bank's challenge is to promote economic and social activity around the train station node where surface parking lots take up valuable land, and are not satisfying parking demand.

White Street Garage Proposal

In 2002, Red Bank tried to address its parking concerns and proposed building a parking structure fronting White Street between Maple and Broad Streets.

While the façade of the structure integrated the facades of nearby landmark buildings, many residents took issue with its scale. When residents looked at an aerial image of the proposal, it was perceived as being a mammoth structure out of scale with the downtown buildings, largely due to the large dimensions of the site. Furthermore, some were opposed to parking decks purely on principle. Ultimately the proposal was voted down.

Had this structure been built, it would have accommodated patrons of downtown stores, but not commuters due to a walking distance of over a quarter mile from the station. Given this combination of circumstances, the studio concentrated our efforts on promoting activity around Red bank's other activity node, the train station.

Political Considerations

A significant issue for the community of Red Bank is the impact of commuters driving through Shrewsbury Avenue, a residential street, to reach the train station. Many commuters driving to the station use Shrewsbury Avenue as a linkage from the Garden State Parkway to the station's surface lots in order to avoid a congested grade crossing. This negatively impacts the residential nature of Shrewsbury Avenue.

The struggle between residents' interests and the regional interests of surrounding communities seeking convenient access to a regional asset must be taken into consideration. Commuters traveling to and from the Garden State Parkway, using Shrewsbury Avenue is a classic example of this tension. Unfortunately, this route is the most efficient for drivers, and it will be difficult to change their behavior. Improved signage leading drivers to the desired corridor of Broad Street and better signalization at the intersection of Broad Street and Newman Springs Rd, along with traffic calming measures on Shrewsbury Avenue, however, may influence the route for many commuters.

Another major political consideration to take into account is public perception of parking structures. As witnessed in the White Street Garage proposal, perception of scale will play a major role in the public's acceptance of a new proposal, so the process must be transparent and inclusive from the beginning. A public visioning process, such as the one conducted in Princeton, would work to soften many people's biases by including their input into the process. As Red Bank considers improving its parking situation, these sensitive issues must be considered.

Existing Parking Inventory

Current parking around Red Bank's train station is primarily provided by NJ Transit (and operated by ParkAmerica) as well as by two privately-owned lots. NJ Transit currently owns six surface parking lots that are operating slightly beyond capacity, with roughly 200 people on a waiting list.

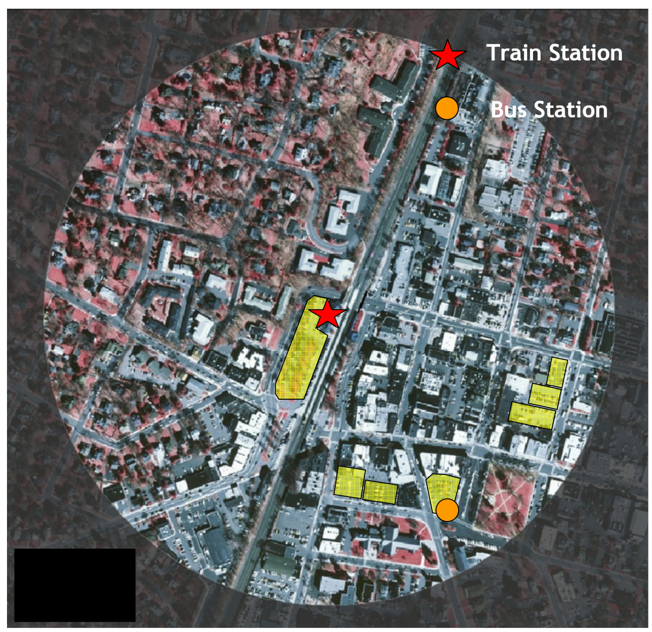
Conversely, the two private lots that serve commuters fill to just 60% of their capacity, probably because they charge 50% more than NJ Transit. This point illustrates that commuter parking demand is highly elastic; parkers will do anything to avoid paying too much for a space. Given that stand-alone commuter parking structures are rarely self-sustaining due to the nature of commuter demand, it is logical for Red Bank to explore the possibility of introducing retail and residential uses, which may provide the needed additional revenue for the structure, as well as add to the Borough's tax base.

VILLAGE OF RIDGEWOOD

The Village of Ridgewood is a wealthy community located in Bergen County, about an hour from Manhattan. The Village's population remained stable at roughly 25,000 throughout the 1990's. Median household income was nearly $105,000 in 2000, more than double the national average. The Village's downtown is thriving, packed full of restaurants, bars, and other entertainment options.

The Makings of a Parking Crisis

The success of Ridgewood's downtown has created a parking crisis as shoppers, commuters, restaurant goers and employees vie for limited space. The Village Chamber of Commerce recently proposed a ban on new restaurant, bank, and salon development partially in response to the parking crisis.[6] The challenge for the Village is to address the shortage of downtown and commuter parking by constructing a structure that will fit into the village fabric, and take advantage of shared parking opportunities so that such bans will not be necessary in the future.



Public service lots in Ridgewood

The Village of Ridgewood first recognized its parking shortage in the 1970's when a consultant identified a 300 space deficit.[7] More than 30 years later a second study conducted by Rich and Associates showed the deficit had grown to nearly 1,300 spaces. The study's

[6] Meeting with J. Fricke, J. Mehandzic, J. Ten Hoeve, March 11, 2005
[7] 1970 Parking Study referenced in Rich and Associates: "Village of Ridgewood Parking Study" May, 2002

authors, however, pointed out that a portion of the deficit could be met through better parking management.[8]

Today, Ridgewood's parking is provided through a combination of public on-street and off-street parking as well as numerous private parking lots. The Village owns and operates seven off-street surface lots within a quarter mile of the train station. Public parking is managed by a parking utility and meters are the only payment mechanism used. Permits, however are still required at several downtown metered lots. The train station lot, for example, is reserved for Ridgewood residents and two other lots are reserved for downtown employees and business owners. [9]

Meters are Ridgewood's only payment mechanism

In the 2002 Rich and Associates Study, the average utilization rate at the city's seven parking lots was calculated to be 89%. In the 12-hour lots, which are frequently used by commuters, the utilization rate was almost 100%. Existing utilization rates have also forced 30% of commuters to park on the street. This hurts local businesses when would-be shoppers cannot find spaces. Given that as much as 30% of Ridgewood commuter parking occurs on-street, this problem is very significant.[10] Furthermore, commuter parking demand will only grow as Secaucus Junction gains popularity and if Ridgewood gets direct train service to Manhattan, as expected in the future. Because of these factors, recent NJ Transit forecasts predict an 80% increase in ridership at Ridgewood over the next twenty years.[11]


On street parking adjacent to train station

Ridgewood is unique in that in addition to its train service, it is also served by two popular express bus routes to Manhattan: the Routes 163 and 164. Currently, there are roughly 10

[8] Rich and Associates: "Village of Ridgewood Parking Study" May, 2002
[9] Meeting with J. Fricke, J. Mehandzic, J. Ten Hoeve, March 11, 2005
[10] Rich and Associates: "Village of Ridgewood Parking Study" May, 2002
[11] NJ Transit

peak hour rail trips into New York and almost 30 peak hour bus trips. The most recent information shows 1,264 daily bus boardings at the Village, compared to 1,166 rail boardings.

The bus's popularity can be attributed to several factors. First, with thirty trips per rush hour the bus clearly offers more frequent service. Second, both bus routes make numerous stops in town, thereby eliminating the need for commuters to worry about station parking, a significant factor in the context of this studio. Lastly, the bus routes both offer the convenience of a one seat ride into Manhattan. Although the bus ride is 15 minutes longer than rail (64 minutes compared to 49), train riders must transfer in Secaucus.[12]

Rail ridership, however, is expected to increase in the coming years. While the bus riding habits of existing residents may be fixed, new residents may be more likely to use the train. There is also a strong likelihood that a single seat ride is in Ridgewood's future, as momentum for a second rail tunnel under the Hudson River grows.

BOROUGH OF METUCHEN

History

Metuchen, New Jersey has a traditional downtown with acres of commuter parking lots adjacent to the downtown train station. The large number of surface lots dedicated to commuters breaks up sections of the downtown. This property could be put to better use while not losing parking spaces. The central challenge is to find higher and better land uses for surface lots, while continuing to support and even expand Metuchen's vibrant downtown, whose local businesses compete with nearby malls with easy highway access and abundant free parking.

Metuchen's central business district

Any recommendations must address the concerns of Metuchen residents and business, including redevelopment and new uses of exiting lots, increase traffic congestion, and the

[12] New Jersey Transit

perception that structured parking is symbolic of an urbanism that is unbecoming to Metuchen.

Many studies and proposals have been put forward for Metuchen over the last 30 years. In 1972, proposals were put forth that recommended an entirely new downtown complete with a new train station and parking garages. A proposal put forward in 1984 also recommended structured parking. A 2000 parking study by Looney Ricks Kiss recommends changes to parking policy as well as structured parking. Proposed redevelopment at the former Stop & Shop would place additional demand on municipal parking.

Metuchen Train Station

Existing Parking Conditions

Metuchen has over 1,500 surface parking spaces spread out over eleven separate parking lots, most of which are located within a quarter mile of the Metuchen train station. Payment methods include long and short-term meters and permits. Meters are $0.25 per hour and permits vary from $25 - $60 per month based on the proximity to the train station; parking for Metuchen residents is discounted in most permit lots. On weekdays, over 95% of the parking is occupied.


Halsey Street Lot (311 space capacity)

The Metuchen Parking Authority manages daily parking operations at both the Metuchen and New JerseyTransit owned lots. Management activities consist of maintaining waiting lists, maintenance and snow removal, and enforcement.

Parking operations net $700,000 per year for Metuchen. The parking authority has been implementing recommendations from the 2000 Parking Study including increasing pricing and


Pearl Street Lot (670 space capacity)

instituting premium pricing for spaces close to the train station.

Transit Village Status

Metuchen was designated a Transit Village in December of 2002. Since the designation, Metuchen has received approximately $600,000 in funding for various Transit Village related initiatives. A portion of the funding has been used for the installation of bike routes along Woodbridge Avenue. Other Transit Village related initiatives include traffic calming projects along Main Street, which has included the installation of bollards and lit crosswalks at multiple intersections within the downtown core.

Gateway Enhancement projects are also being considered along the main thoroughfares leading into Metuchen from Route 1, particularly the entry into the borough from Woodbridge Avenue. Metuchen's main objectives are to use these types of projects to encourage the use of non-motorized transportation, while discouraging the use of the automobile. This will ideally reduce the vehicle-miles traveled within the borough and help relieve traffic congestion within the downtown.

Residential Development

There has been no shortage of residential development within the central business district of Metuchen. Two relatively high-density residential complexes have recently been developed at the northwest edge of the central business district. What is significant about this new development is that it is compactly developed and is within close proximity to the Metuchen train station.

Franklin Square, which is located at Middlesex and Central Avenues, was completed in 2002 and is comprised of 101 condominiums, 15 of which are affordable. It is located within a half mile of the train station and is thus within walking distance to the main activity nodes of Metuchen.

Franklin Square

Central Square is the other new, compactly developed residential complex in Metuchen and is located on Central Avenue. It was completed around the same time as Franklin Square and is a mixture of condominiums, flats, and affordable housing units. It is located exactly a half mile from the train station and is within walking distance of the retail core and the train station.

The existing housing stock within the retail core consists mainly of one and two bedroom apartment units above retail store frontage along Main Street. The typical rents for such apartment units range from $1,200 to $2,000 per month.

The new residential development in Metuchen has been generally successful in terms of the transit village program's goals and objectives, but a recent survey, conducted by the Voorhees Transportation Center, has shown that the majority of Metuchen residents do not favor additional residential development in the borough. This perception may be resulting from the rapid development of these residential complexes and from the general perception that new housing brings more traffic and school children.

Central Square

Retail Conditions

Metuchen's retail core is located along Main Street and is comprised mainly of service establishments. Currently, there are no national retailers in the retail core, but there is a large presence of restaurants and coffeehouses along Main Street. Many of the retail establishments that once comprised a larger portion of Main Street disappeared soon after the Woodbridge and Menlo Park Mall's openings, both of which are located within four miles of Metuchen. Consequently, Metuchen's downtown is not a full service retail core. The fact that the retail core is service oriented may have certain implications for parking availability during lunchtime and dinnertime hours during the weekday.

On-street parking on Main Street

According to the Looney Ricks Kiss parking survey conducted in 2000, 16% of shoppers and visitors looking for parking in the retail core found it difficult to find a parking space at peak hours along Main Street and 17% found it difficult to find parking at anytime during the day. This, again, may be the result of a disproportionate share of service establishments in the downtown core.

Traffic and Circulation

The main local thoroughfares within Metuchen are Middlesex Avenue (Route 27), Woodbridge Avenue, Amboy Avenue, Grove Avenue, and Main Street. These roads are well traveled and the source of traffic within the downtown core of Metuchen. A recent engineering study suggests changing the signalization at key intersections in Metuchen, which could potentially move more traffic through town more smoothly, if done correctly.

Parking Structures: Development Solutions

Metuchen has a tremendous amount of surface parking lots, more than 90% of which are located within a quarter-mile of the train station. The large amount of impervious surfaces within the downtown limits future residential and commercial development opportunities and creates gaps in the urban fabric. Metuchen's challenge is to find higher and better land uses for the existing surface lots, while continuing to support current commuter activity and future growth. This may be accomplished through the provision of strategically placed parking garages. After an analysis of the existing conditions in Metuchen and reviewing prior parking structure proposals, the studio proposed alternatives for parking and development for the Halsey Street and the Pearl Street lots.

BRICK CHURCH STATION, EAST ORANGE

Brick Church Station in East Orange presents a variety of challenges. Since the institution of Midtown Direct service to New York in 1996, ridership from Brick Church has increased nearly 400%.[13] With increased ridership, commuter parking needs have spiked considerably. Proximity of Brick Church Station to Route 280 provides a steady stream of commuters from towns farther west.

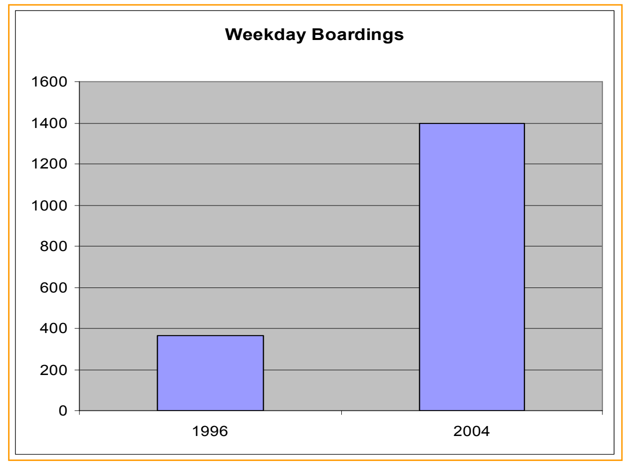
East Orange also has ambitious plans for redevelopment; there are three projects within a quarter-mile radius of the station. Because of these conditions, the 2004 revisions to the city's master plan identified parking as a major concern.

[13] NJ Transit Rider Surveys, 1996, 2004.

Finally, there are some major urban design shortcomings at Brick Church. The historic, Georgian train station is cut off from the main street by two suburban-style retail buildings at which inadequate pedestrian facilities and poor lighting contribute to a perceived lack of security.

Parking Inventory and Managment

Commuters to Brick Church station utilize two publicly-owned parking facilities. The primary facility is the Halsted Street lot, adjacent to the outbound platform, directly across Halsted Street from the station building. Several years ago NJ Transit was involved in discussions concerning the purchase of an adjacent lot owned by Faith Church, but nothing came of the talks. NJ Transit also operates a small strip of parking beneath the train viaduct, which is not well-used due to its awkward location and perceived lack of safety. Many commuters opt simply to illegally use the parking lots at Brick Church Plaza Shopping Center and Forman Mills Store.



TOP: Graph shows increase in ridership from Brick Church since 1996. In 1996 there were 357 daily boardings while in 2004 nearly 1,400 daily boardings were reported.
BOTTOM: The Brick Church Station House is hidden behind two suburban-style retail buildings

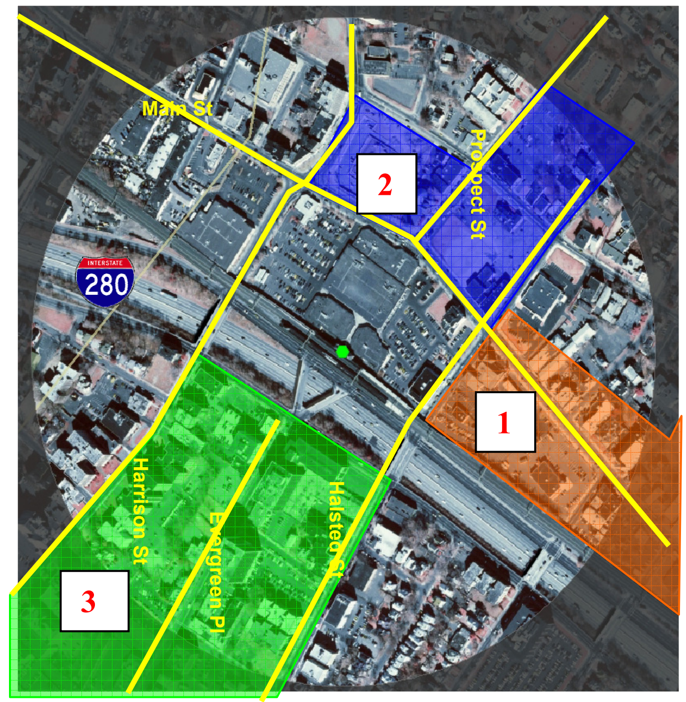
There are currently five separate entities that deal with parking in East Orange. The city's Department of Policy, Planning, and Development acts as the clearinghouse and coordinator of all major development in East Orange and guides development of any new major parking structures. East Orange's Parking Authority manages several lots scattered throughout the city, but for various reasons does not serve as the central coordinating body and is it not a visible part of city government. Due to this vacuum of power, various other entities are left to manage different responsibilities of parking management in the city.[14] With this existing situation in mind, the 2004 master plan

[14] East Orange Department of Policy, Planning and Development; NJ TRANSIT

advised a "more efficient management of parking lots near commercial and employment areas."

Redevelopment Projects in East Orange

In East Orange, there are many redevelopment and revitalization efforts underway or being planned citywide. Three are in the immediate vicinity of Brick Church Station and will undoubtedly increase travel demand from that node.



1 = Lower Main Street
2 = Muir's Berkeley
3 = Evergreen Place

Lower Main Street (also known Martin Luther King Boulevard) serves as East Orange's downtown. The centerpiece of this redevelopment plan is a new school and a 1,200-seat performing arts center, funded by the New Jersey School Construction Corporation, which includes arts related program such as coffee shops, cafes, and fine restaurants.

Across Martin Luther King Boulevard from Brick Church station is the Muir's Berkeley site, which has been developed in three phases, each covering one block. The first phase is the Dr. Martin Luther King, Jr. Plaza; a mixed-use building with 104 apartment units (many of them affordable), street-level services, a restaurant, and parking facilities for residents, shoppers, and diners. The second phase is a similar mixed use building featuring apartments and ground-level shops and restaurants. The third phase consists of 18 townhouses.

New apartments under construction at the RPM Muir's Berkeley site, viewed from the rail platform at Brick Church, March 2005

Evergreen Place is a large area opposite Interstate 280 from the Brick Church Station. The area contains many old office and apartment buildings. The space will be redeveloped in two phases. Phase one will include a large hotel and convention center in the northern part of the site, closest to the interstate. The convention center will allow East Orange to compete with other nearby cities for conferences and other events. South of the hotel and convention center, efforts will focus on rehabilitating neglected residential and office buildings.

Beyond the immediate Brick Church area the city has plans for redeveloping and rehabilitating other neighborhoods. In the city's northern corner are the grounds of the now-closed Upsala College. The plan for the area calls for upscale single-family detached homes and townhomes. Around Walnut Street, the city has a plan for redeveloping a neglected neighborhood into a more habitable residential community. The plan calls for brownstone rowhouses, loft apartments, and the revitalization of an underutilized park. There will be a parking ratio of one space per residential unit.

One of the principal commercial areas in East Orange is the Central Avenue corridor. Streetscape improvements and modifications are prescribed for the area. There are also plans to bring more retailers to the area and a five-screen movie theater is scheduled to open in a few months.

Greenwood is a residential community on the city's border with Newark containing a number of vacant lots, due to neglect and abandonment. The City's planning office intends to engage in a slow, organic redevelopment process, employing many small developers to work on a few parcels at a time.[15]

Transit Village Concept Development Proposal

The burgeoning need for commuter parking at Brick Church, the redevelopment synergy East Orange has created, and the inefficient land use adjacent to the station suggest a comprehensive plan for redevelopment. This could include the large-scale redevelopment of the Brick Church Plaza site into a dense, mixed-use transit-oriented development. A parking facility there could serve residents and commuters who use the Brick Church station. It could also serve residential and retail users.

[15] East Orange Department of Policy, Planning and Development

Appendix C: Site Solutions

Each community had either two or three graduate Architecture students assigned to develop alternative proposals that test the guidelines and practices. The proposals focused on attempting to integrate a variety of mixed uses as identified in the section on Mixed Use Opportunities and address a variety of scales. These uses include housing, retail/dining, municipal uses, public and recreation uses, and integration into wider development initiatives such as development rights swap or sale for a hotel, and a massive entertainment complex.

This Appendix is organized by municipality and includes, for each proposal, one page of bulleted text highlighting the key elements of the proposal followed by several pages of images illustrating key points parts of the solution.

The proposals that follow include:

1) Red Bank – housing focus, some retail – Alok Sakseena
2) Red Bank – housing, retail, and nursery – Vidal Guzman
3) Red Bank – housing focus, some retail – Leslie Marchio

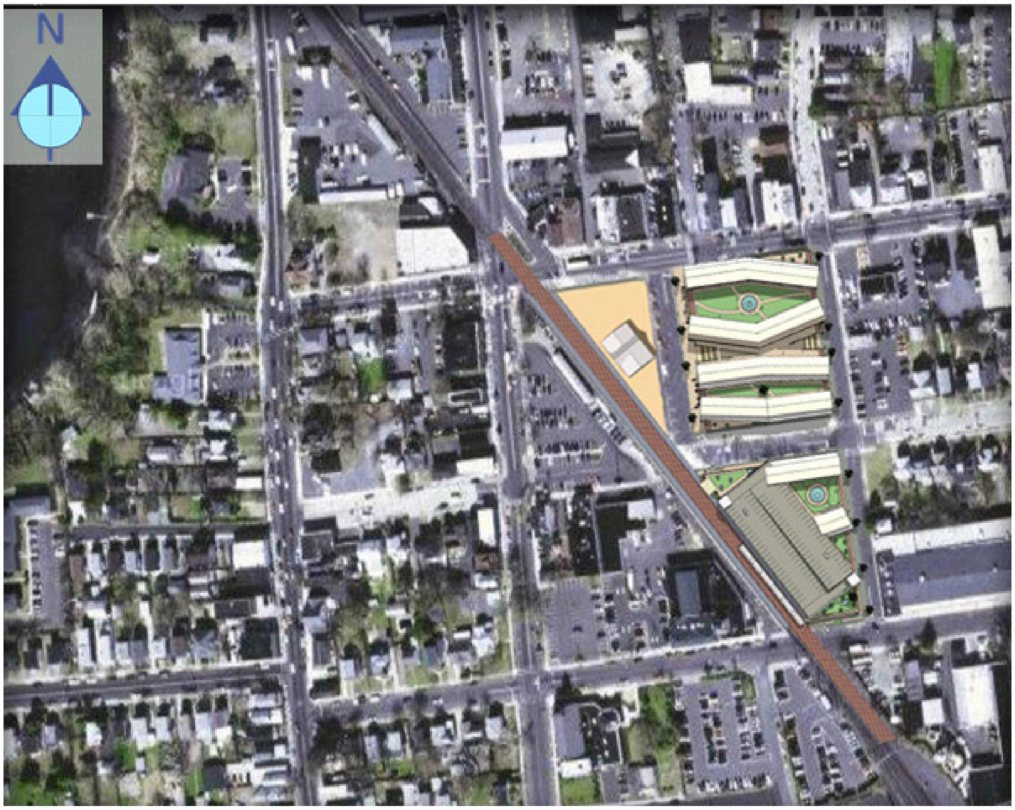
4) Ridgewood – retail, housing – Ken Sirower
5) Ridgewood – hotel, housing, some retail – Rob Holmes
6) Ridgewood – library, some retail – Scott Graham

7) Metuchen - performing arts, non-profit, some housing, retail – Walter Kziasak
8) Metuchen – housing, retail – Michael Marmion
9) Metuchen – civic/public use, greenway, housing, retail – Tony Okoye

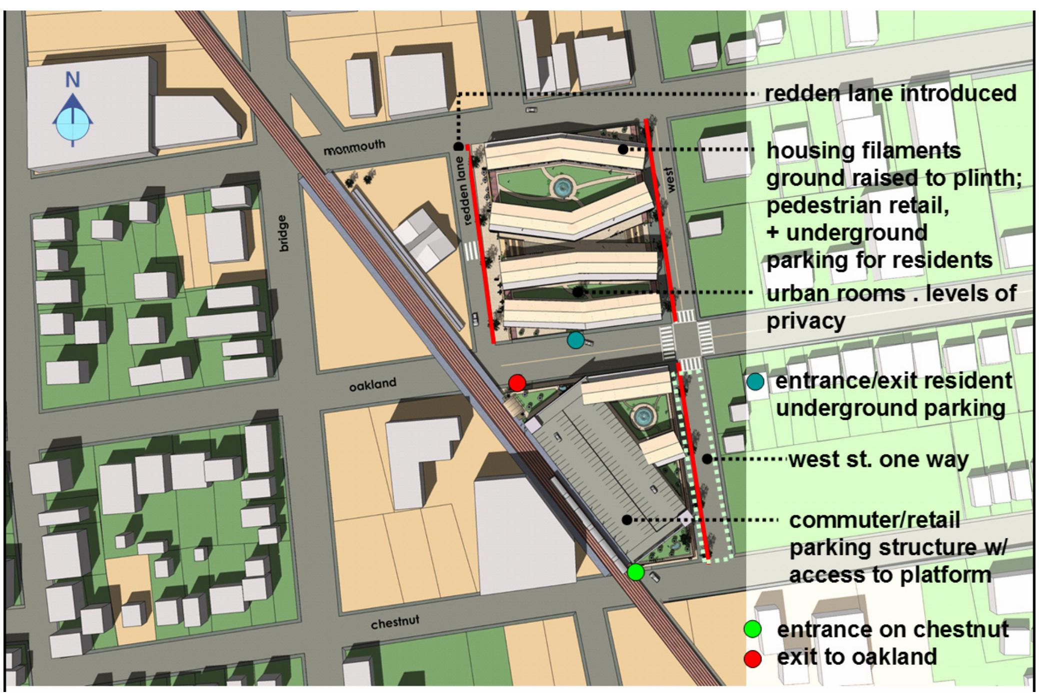
10) East Orange – housing, retail, recreation center – Dan Bakogiannis
11) East Orange – mega complex, entertainment, retail, housing – Mounir Tawadrous

Location: Red Bank, NJ
Student: Alok Sakseena

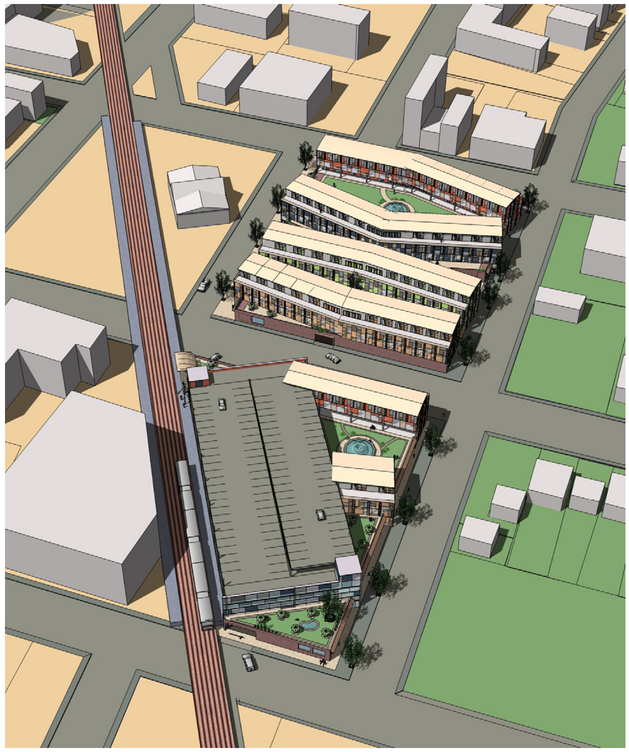
- Ground raised to plinth at east side of station (present lots 2, 3 & 4)
- New traffic patterns:
  - new road introduced (Redden Lane)
  - traffic pattern altered on one existing road (West St. – one way)
- Parking solution comprises two elements:
  - underground parking for tenants & retail – 233 spaces
  - adjacent parking structure for commuters – single helix – 30 ft. bays – 320 spaces
- Mixed use elements are housing and retail
- Housing set on 20 and 30 ft bays:
  - 50 single room apartments in 20 foot bays
  - 30 duplex apartments in 30 foot bays
  - gated for security / privacy
- Estimated Total cost (hard and soft): $51.0M
- Estimated break even cash flow in Year 5



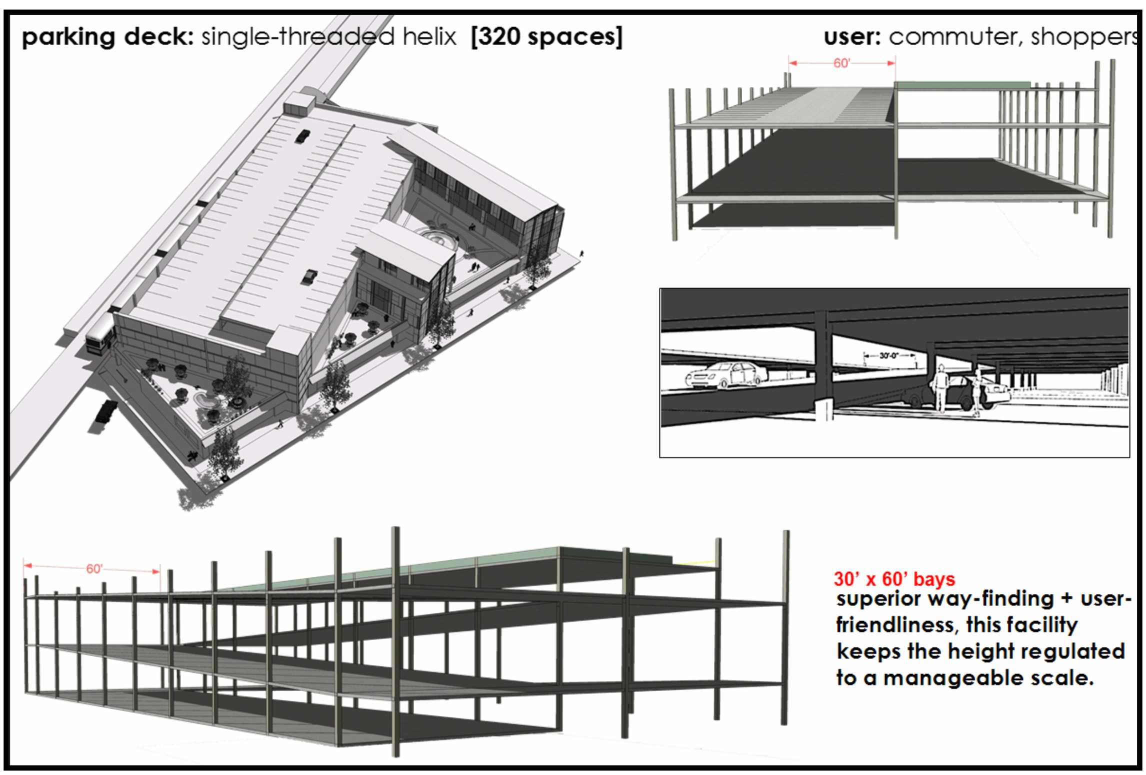
Aerial View of Red Bank with proposed solution inserted



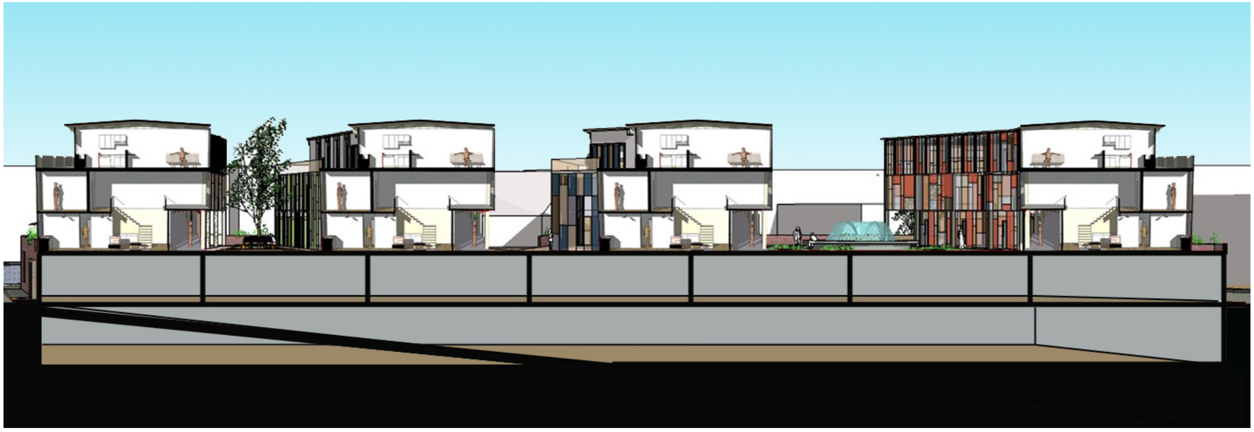
Components of proposal highlighted



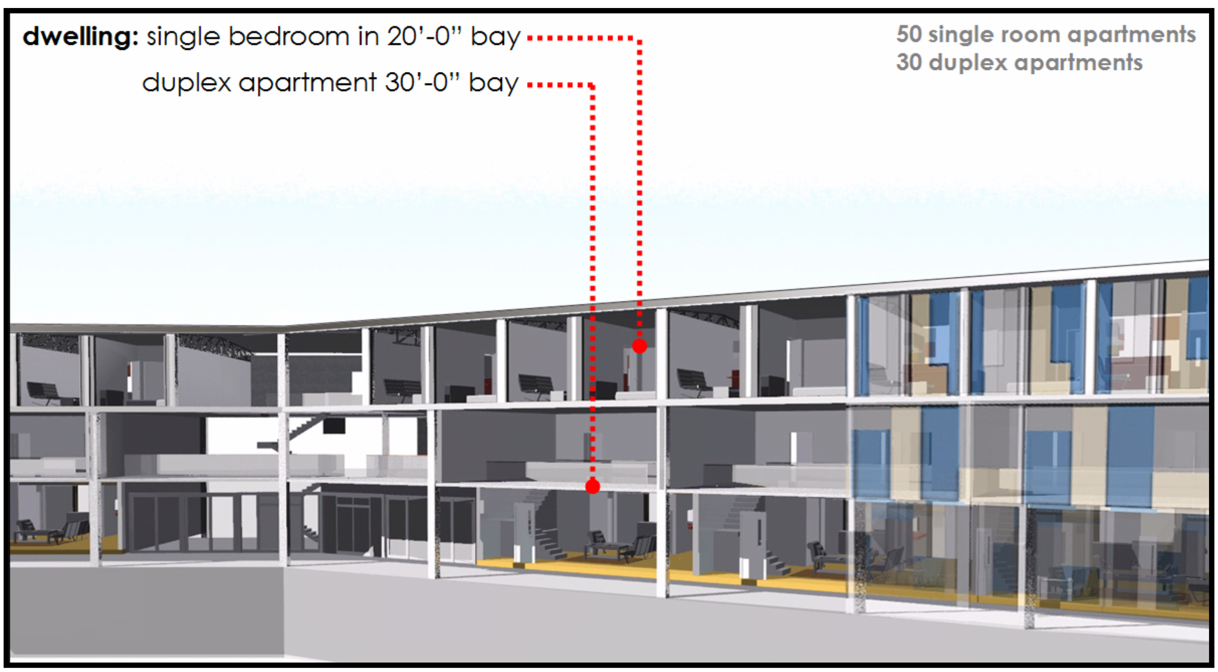
Aerial rendering from south – parking foreground, housing attached and rear



Parking details



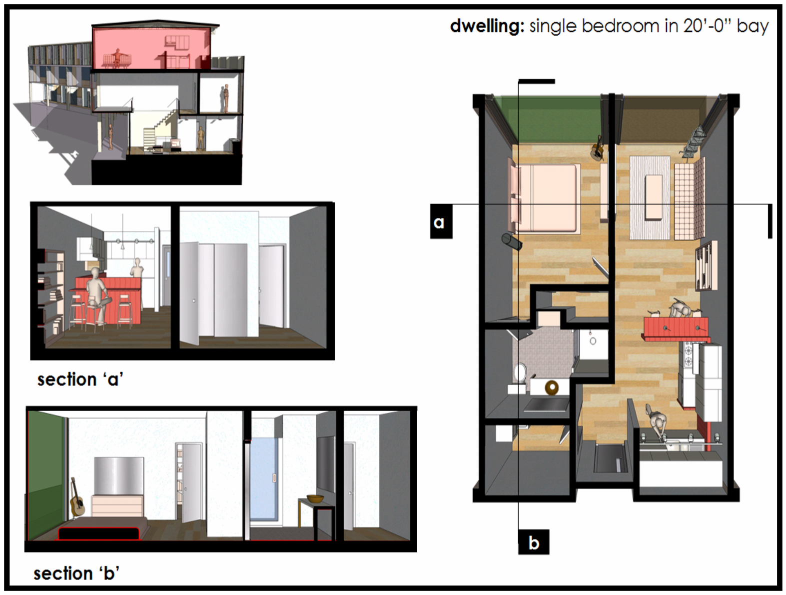
Section through housing filaments from East – residential dedicated parking below



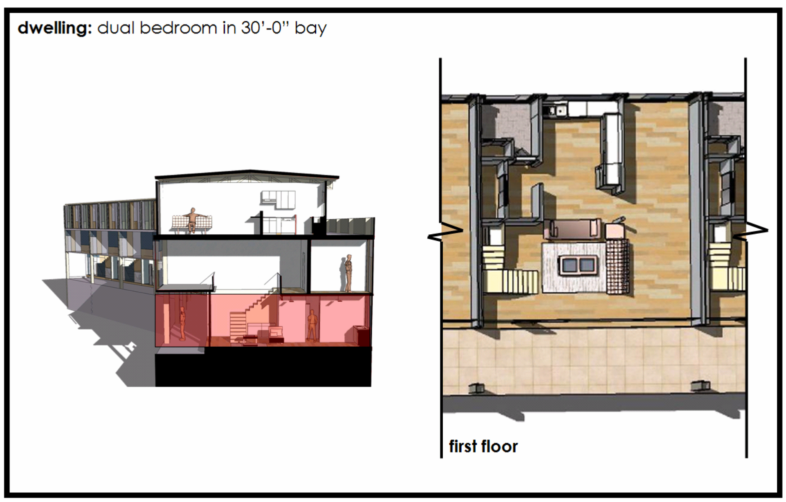
Typical housing filament revealing relationship of single to duplex units

Rendering of central plinth

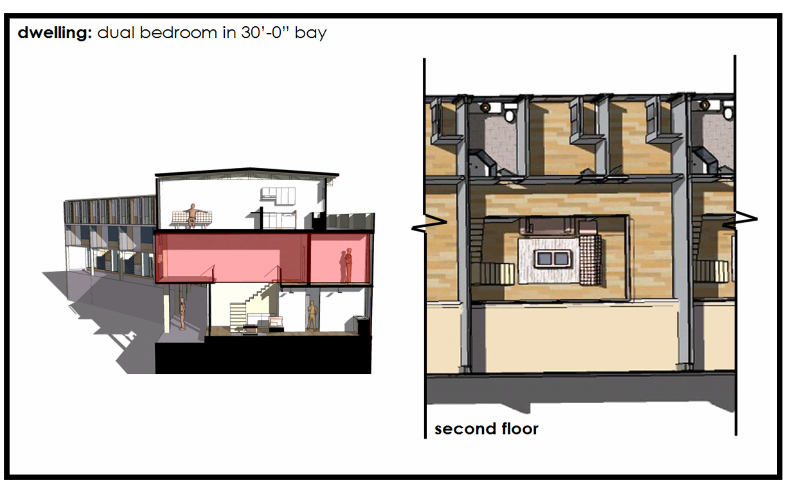
Rendering of housing courtyard



Single unit - sections and plan



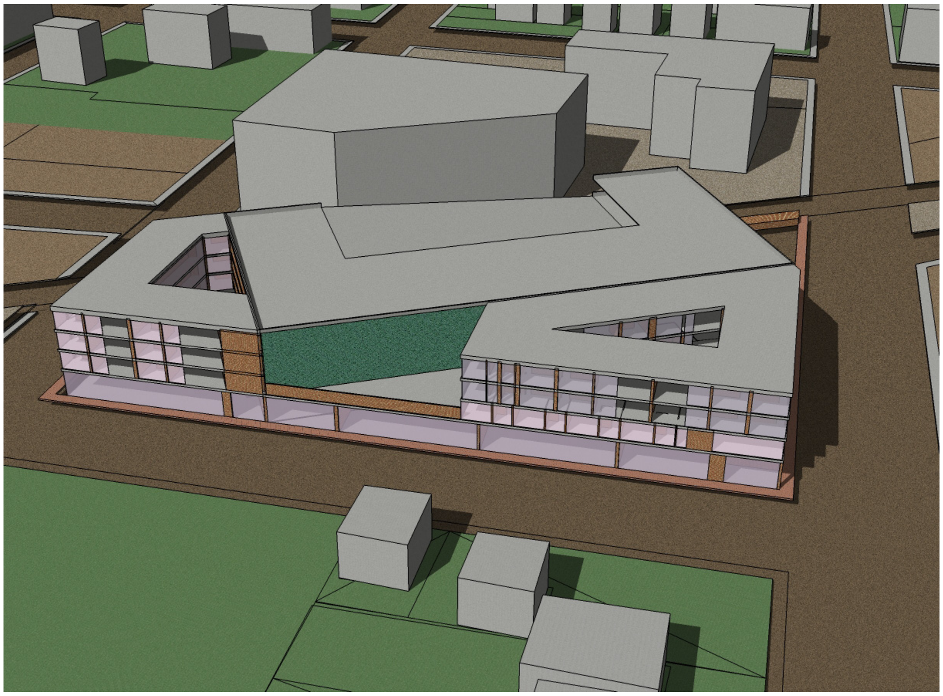
Duplex unit – entry level



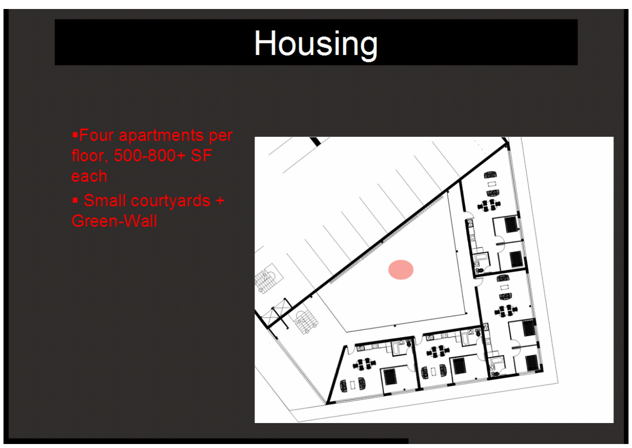
Duplex unit – above level

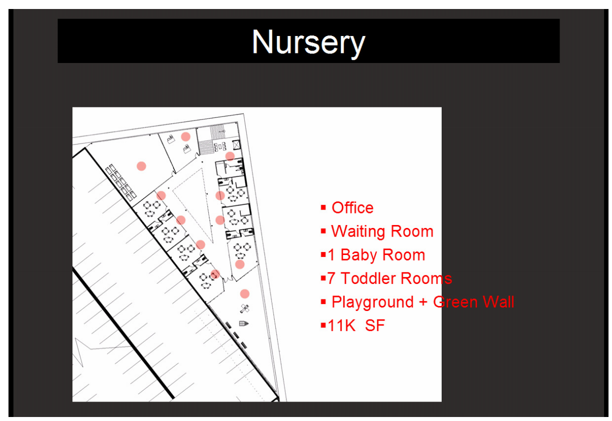
Location: Red Bank, NJ
Student: Vidal Guzman

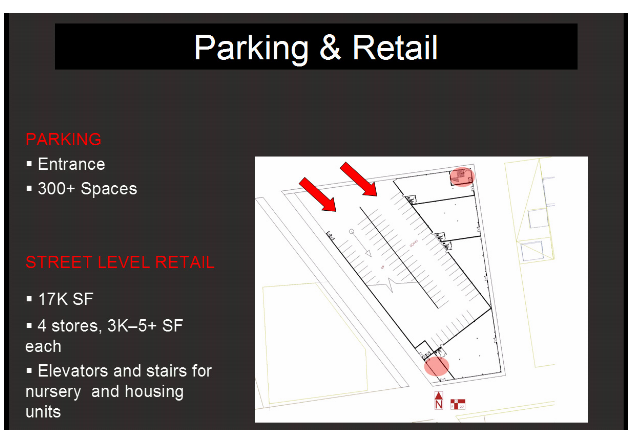
- Parking solution comprises one structure:
  - single helix – 4 levels - 300+ spaces
- Mixed use elements are housing, retail, and nursery
- Housing:
  - 4 apartments per floor, three floors
  - 500 – 800 sf each – 8,000 sf total
- Retail:
  - 4 stores at grade
  - 3,000 – 5,00 sf each – 17,000 sf total
- Nursery:
  - 7 toddler rooms, 1 baby room, waiting room, office, playground and green wall
  - 11,000 sf total
- Estimated Total cost (hard and soft): $13.2M
- Estimated annual income (gross ?): $2.1M

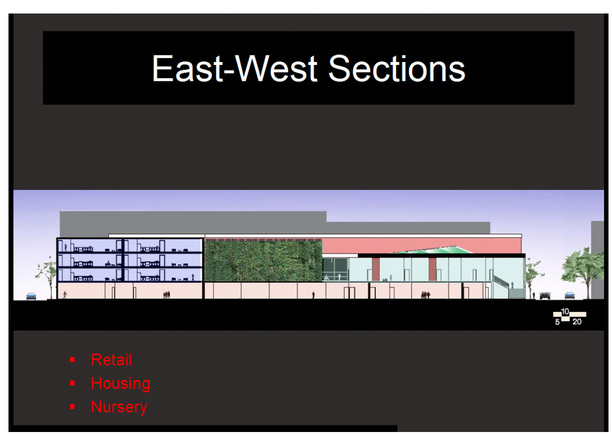


Aerial diagrammatic view of proposed solution looking west
Housing at left, nursery at right, parking at center, retail at grade





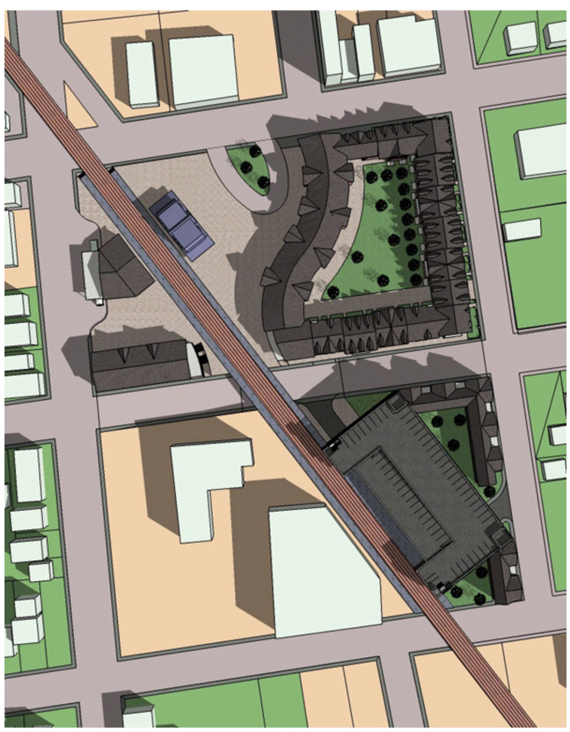




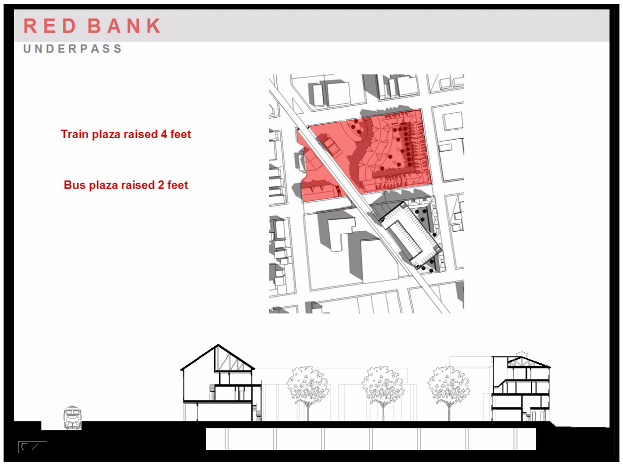
Location: Red Bank, NJ
Student: Leslie Marchio

- Create an underpass @ Oakland St.
  - raise train plaza 4 feet
  - raise bus plaza 2 feet
- New traffic patterns:
  - move/redirect bus traffic to Bridge St.
  - West St one way below Oakland St.
- Parking solution comprises one structure:
  - single helix – 5 levels - 415 spaces (+125 net new)
- Mixed use elements are housing and retail
- Housing:
  - Townhomes; +/- 1,500 sf each, 2BR, 2 bath , 24 units, target sale price $600K
  - Duplexes; +/- 1,350 sf each, 2 BR, 2 ½ bath, 24 units, target sale price $560K
  - Lofts; +/- 2,100 sf each, 1+BR, 2 bath, 14 units, target sale price $840K
  - Condos; +/- 775 sf each, 1 BR, 1 bath, 32 units, target sale price $360K
- Retail:
  - 15K sf total
  - estimated annual revenue $1.7M, annual cost $640K
- Estimated Total cost (hard and soft): $43.0M (including $4M for underpass/plaza)
- Estimated housing sales income: $51.0M

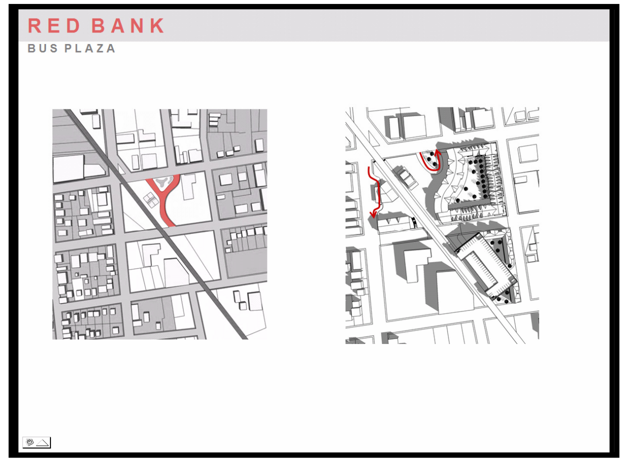
Aerial view of Red Bank – existing NJT lots



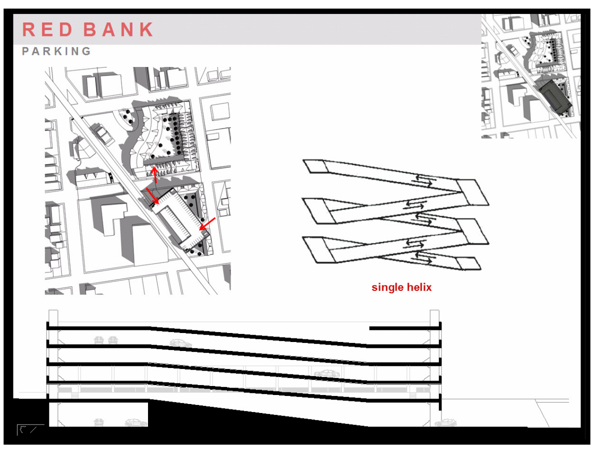
Proposed solution components



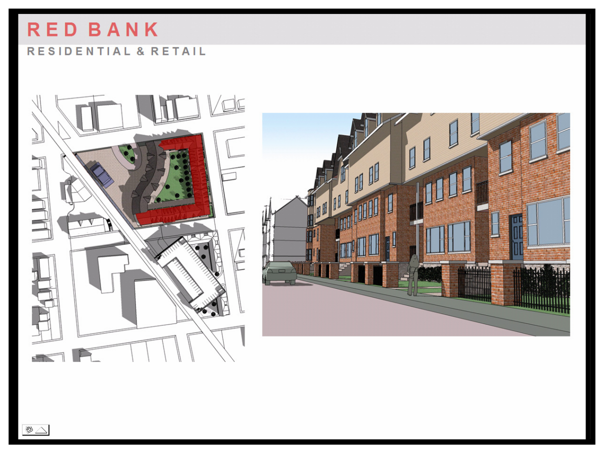
Underpass



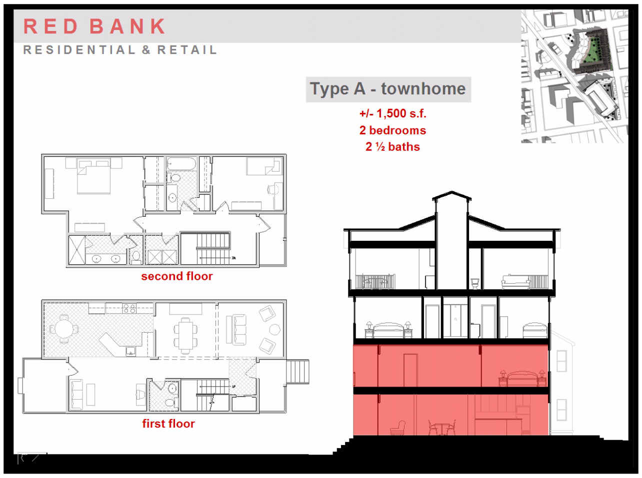
Bus Plaza

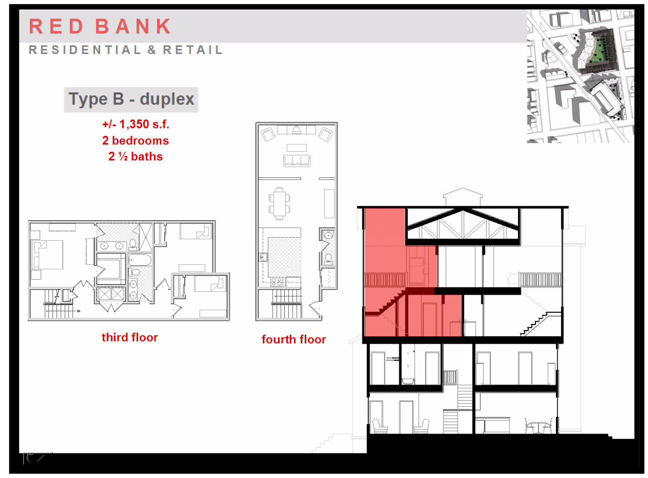


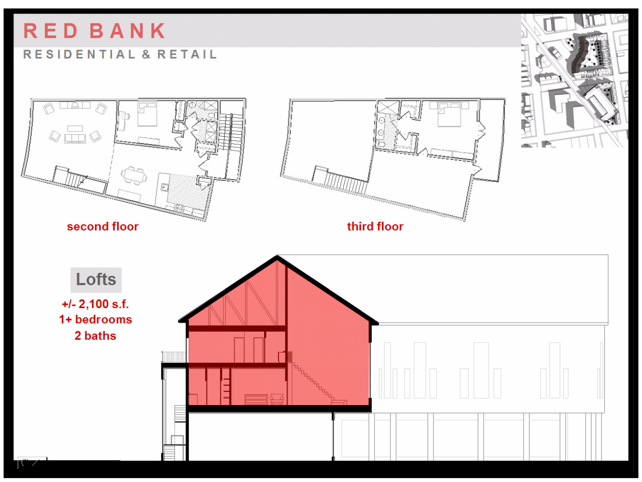
Parking Structure

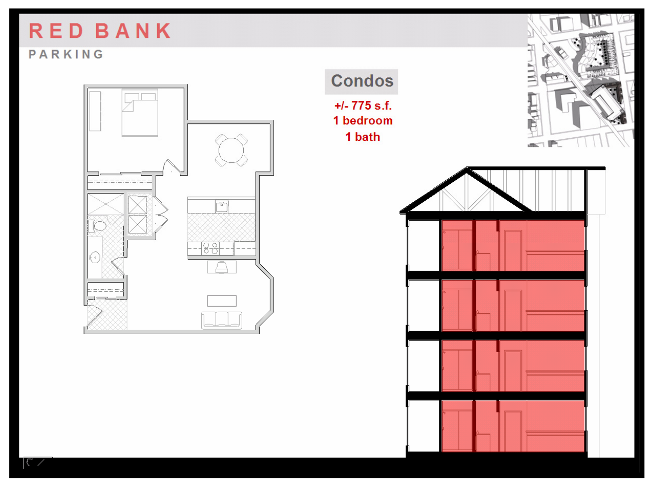


Residential/Retail form







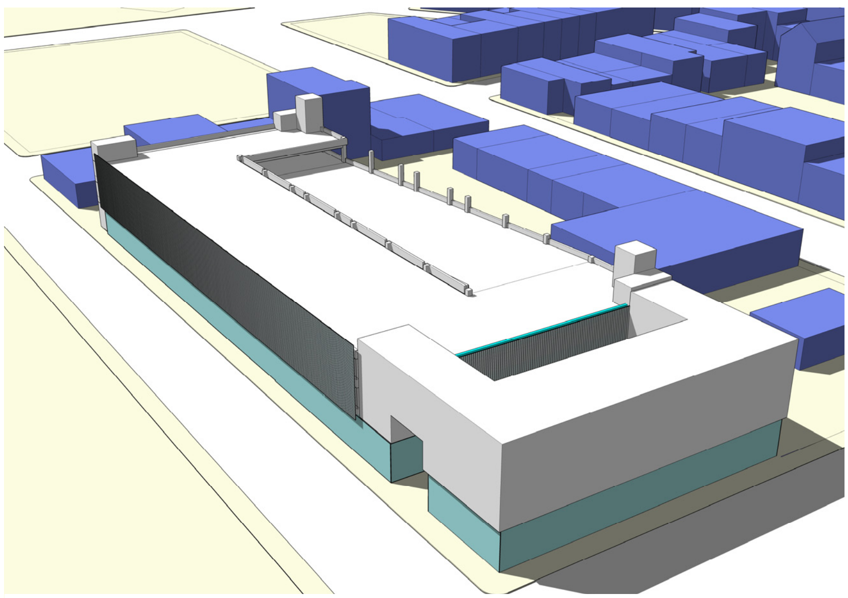


Housing: Unit Types

Location: Ridgewood, NJ – Walnut St. Lot
Student: Ken Sirower

- Parking solution comprises one structure:
  - single helix – footprint is 366' by 128'
  - 354 total spaces; 287 on levels 1 &2 for retail/restaurant, 67 on level 3 for comm.
  - stair & elevator tower at north corner primarily for commuter use
  - stair and elevator towers at SE & SW for CBD and commuter use
- Mixed use elements are housing and retail
- Housing:
  - 7 units
- Retail:
  - 12 units at street level
  - create 'Ridgewood Walk' – pedestrian mall
- Estimated Total cost (hard and soft): $15.5M
- Estimated annual revenue (gross?): $1.4M

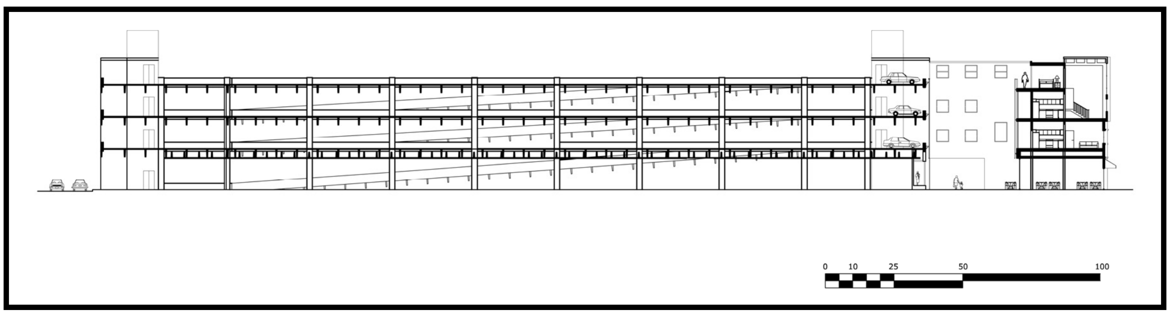
Ridgewood CBD with commuter routes to station



Proposed structure with housing in foreground, parking beyond

Rendering of housing and garage façade at corner of Walnut and Franklin

Walnut Street Elevation – garage façade over retail units - Ridgewood Walk at right



Garage Section – Walnut Street

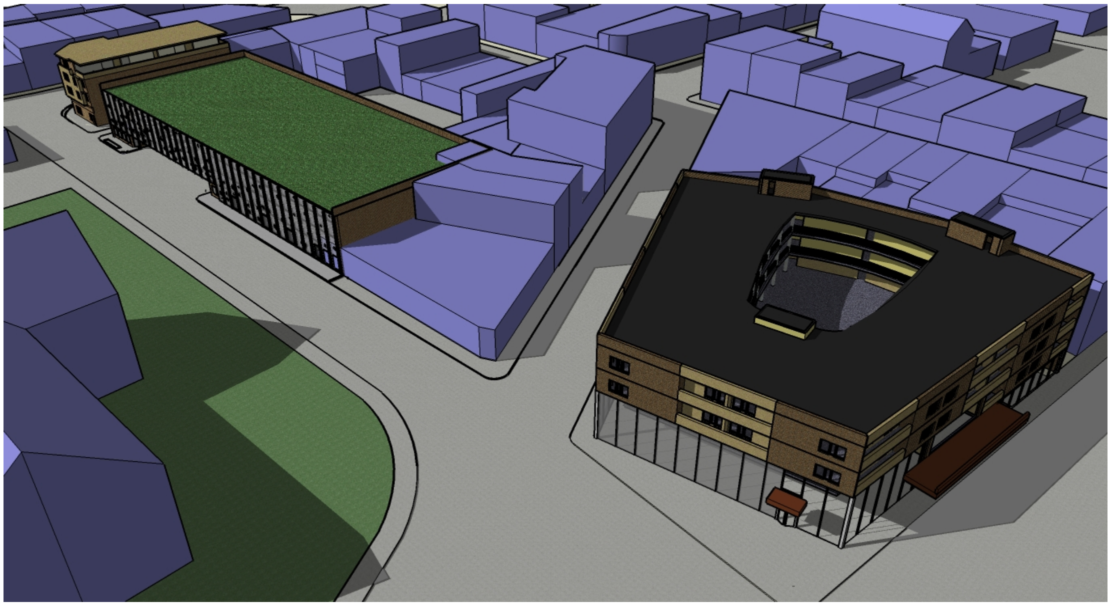
Ridgewood Walk - daytime

Walnut Street Elevation – garage façade over retail units – evening

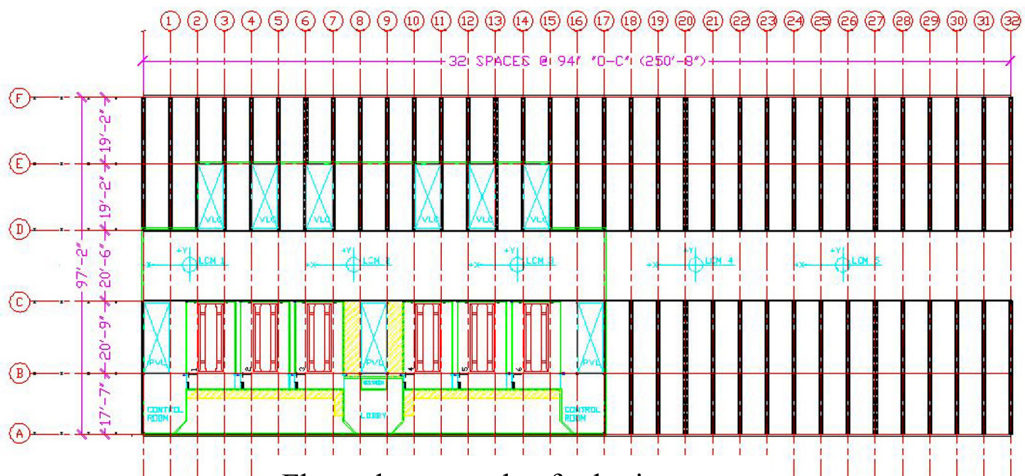
Ridgewood Walk - evening

Location: Ridgewood, NJ – Hudson & Prospect St. Lots
Student: Rob Holmes

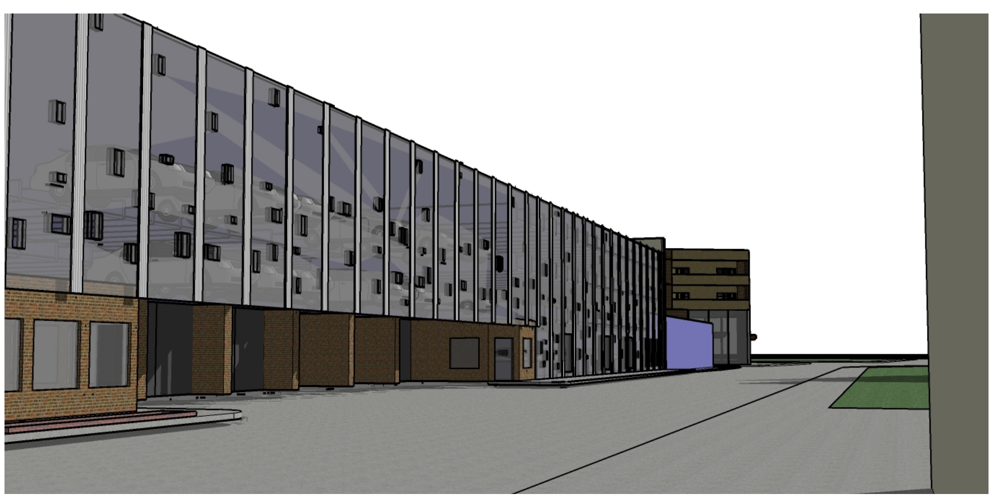
- Use Robotic Parking to reduce parking footprint 40%, increase capacity 240%
  - Move bus depot from Prospect lot to Barker Square
  - consolidate Prospect St. and Hudson St. surface lots into Hudson footprint
  - 4 levels (one below grade) - 454 spaces (+320 net new)
  - free Prospect lot for community magnet; boutique hotel @ Van Nest Square
- Mixed use elements are hotel, housing and retail
- Hotel:
  - 46 rooms, bi-level restaurant, grand ballroom and ceremonial stair
  - 88,00 sf total, 4 floors, one below grade
- Housing:
  - 4 flats; +/- 1,250 sf each, 1BR, 1 bath
  - 4 Duplexes; +/- 2,200 sf each, 2 BR, 2 bath
- Retail:
  - 4 units fronting Broad St., 5,000 sf total
- Estimated Total cost (hard and soft): $28.9M
- Estimated annual Net Income to VOR: $1.9M, payback in 15 years



Aerial diagrammatic view of proposed solution components:
robotic garage with green roof, housing at rear, hotel in foreground

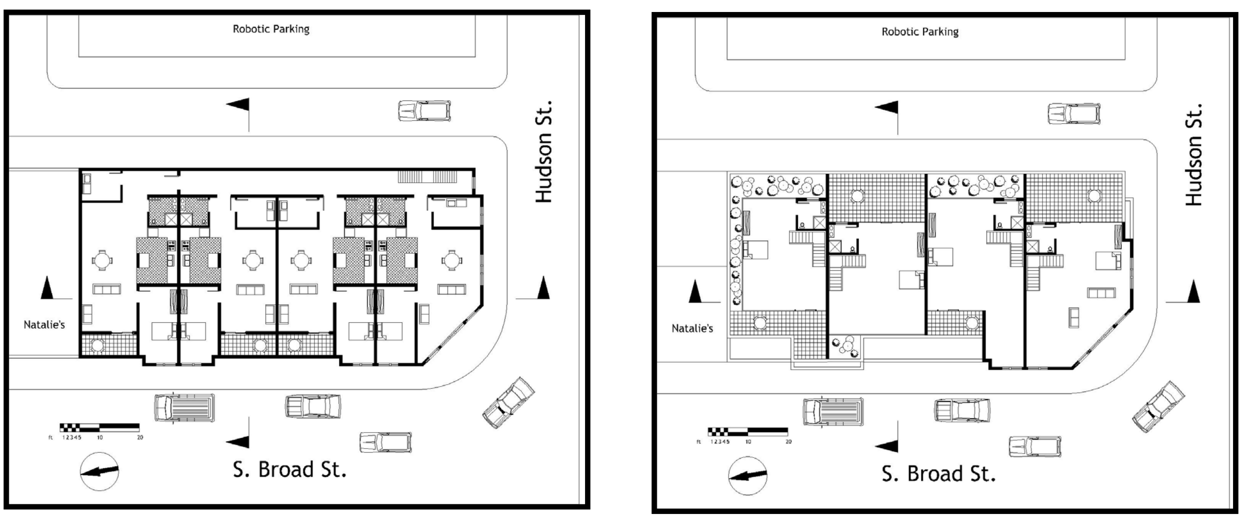


Floor plan at grade of robotic garage

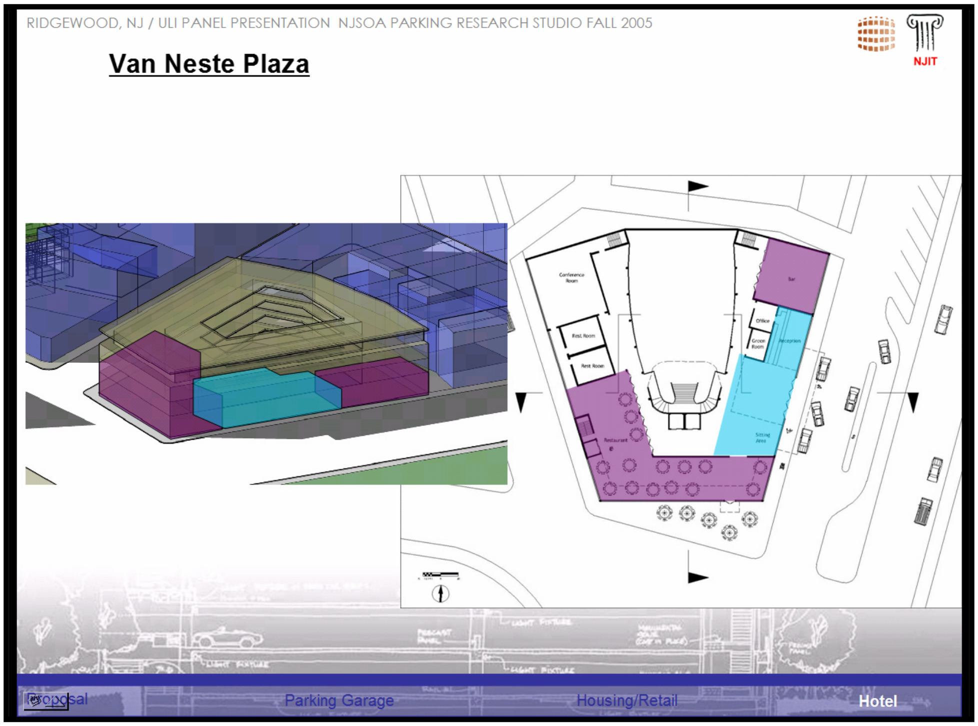


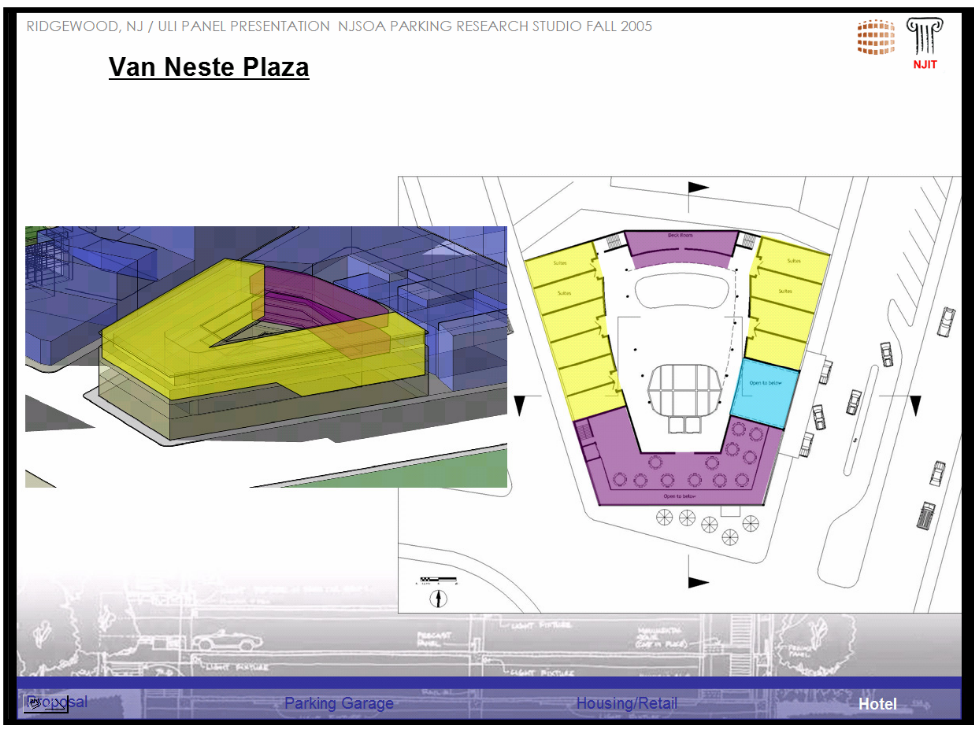
Perspective of robotic garage – entry portals

Rendering of Broad St. elevation: housing over retail units



Floor plans of duplex housing units: 3rd & 4th floors



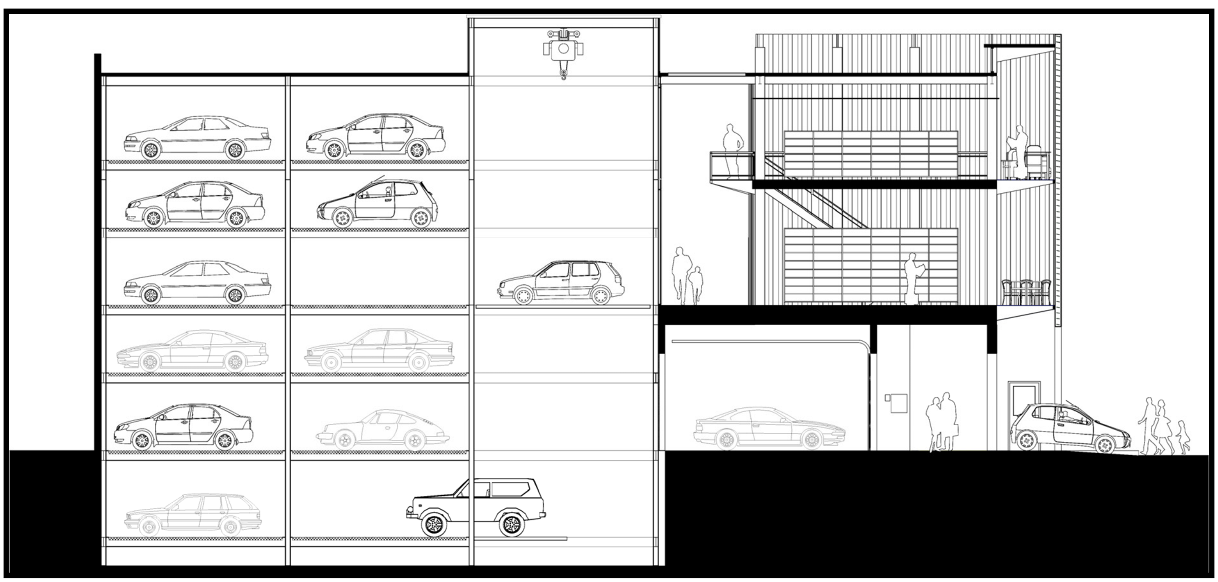


Diagrammatic plans of Hotel: entry level and 2nd floor

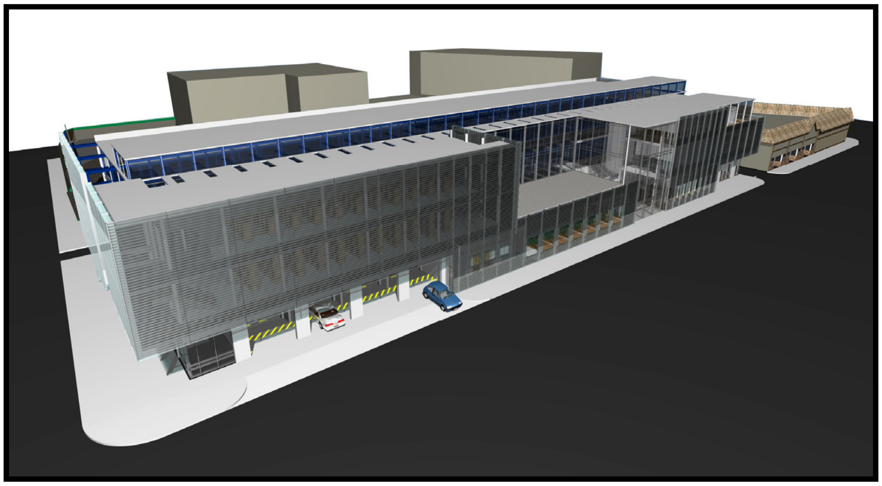
Location: Ridgewood, NJ – Hudson St. Lot
Student: Scott Graham

- Use Robotic Parking to increase capacity 160% on same footprint
  - 6 levels (one below grade) - 340 spaces (+210 net new)
- Mixed use elements are library and retail
- Library:
  - two levels of stacks, offices, terrace
- Retail:
  - restaurant, storefronts fronting Hudson St.
- Estimated Total cost (hard and soft): $13.6M
- Estimated annual Net Income to VOR: $-.2M (library a municipal net expense)

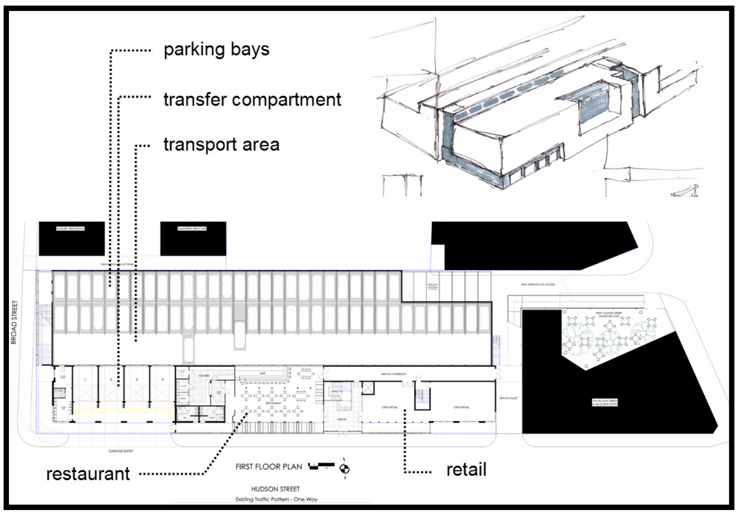
Streetscape from Broad and Hudson - rendering



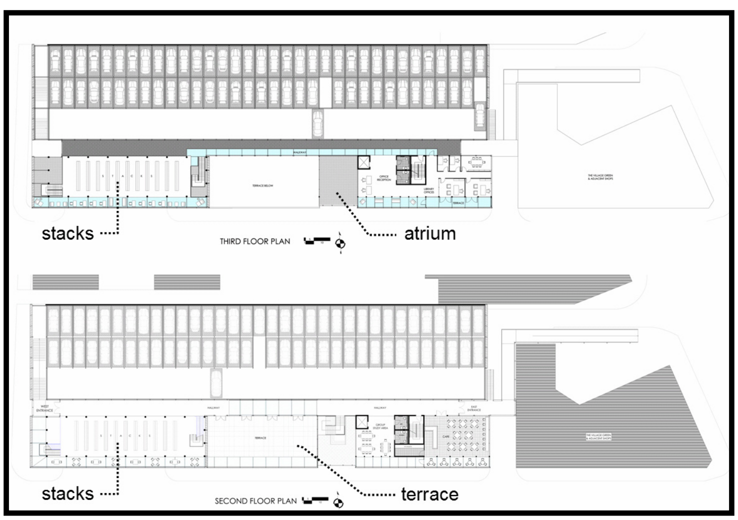
Section from Broad St. – through robotic mechanism, and library and transfer compartments



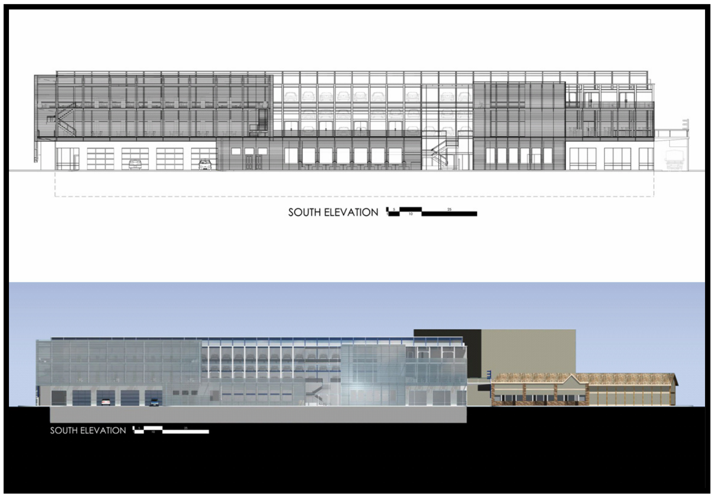
Aerial view from SW - rendering



First Floor Plan

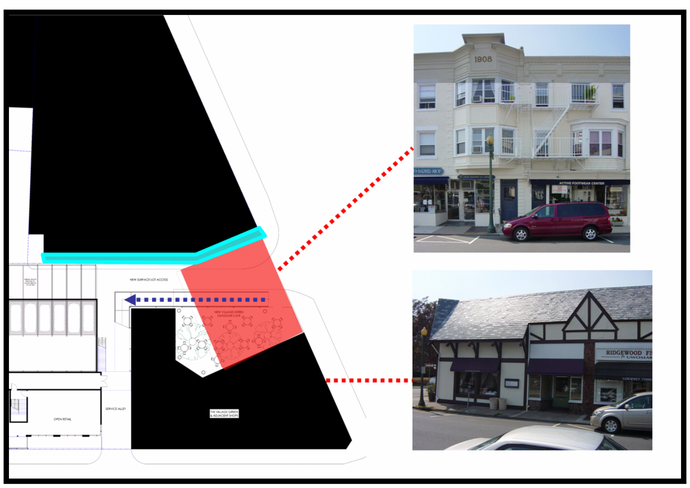


Upper Floor Plans



Hudson Street Facade

Hudson Street streetscape

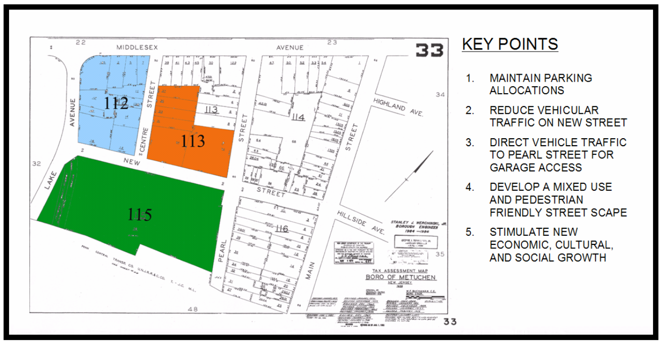


Prospect Street pass through solution

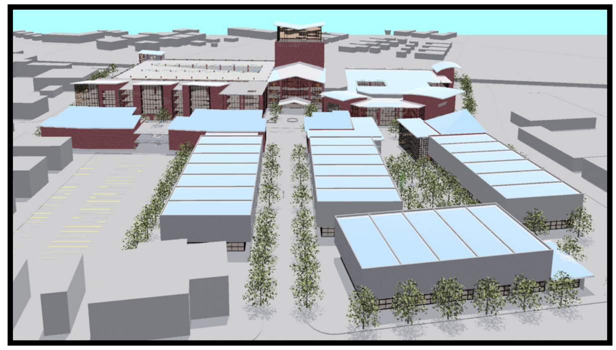
Restaurant rear yard and pedestrian ramp

Location: Metuchen, NJ – Pearl St. Lot
Student: Walter Kziasak

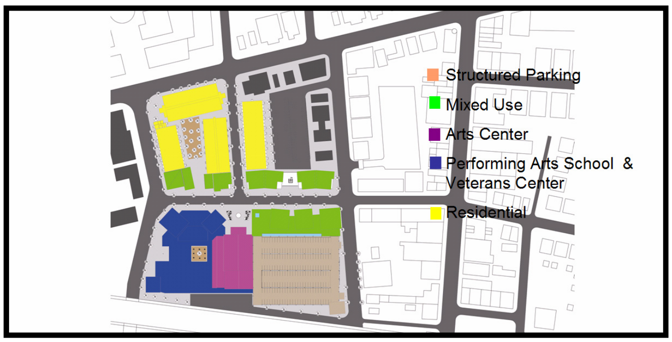
- Includes blocks 112 and 113 (beyond original block 115)
- Parking solution comprises one structure:
  - double helix – 4 bay, 72,000 sf per floor, 200 spaces per level
  - 4 levels – 288,000 sf total, 800 spaces (100 net new)
  - stair & elev tower at north corner primarily for commuter use
  - stair and elev towers at SE & SW for CBD and commuter use
- Mixed use elements are cultural (Performing Arts School and Arts Center), civic (Veterans Center), housing and retail
- Non-profit: 141K sq ft
- Commercial: 104K sq ft
- Housing (164K sf total):
  - Townhomes; +/- 2,250 sf each, 2BR, 2 bath , 45 units, target sale price $562K
  - Lofts A; +/- 1,890 sf each, 2 BR, 2 bath, 16 units, target sale price $500K
  - Lofts B; +/- 1,620 sf each, 2BR, 2 bath, 20 units, target sale price $409K
  - Lofts C; +/- 970 sf each, 1 BR, 1 bath, 4 units, target sale price $228K
- Retail: 58K sq ft
- Estimated Total cost (hard and soft), including land acq. blocks 112,113: $151.2M
- Estimated residential sales revenue: $42.4M
- Estimated annual tax revenue : $31.8M



Overview of Proposal site and Principles



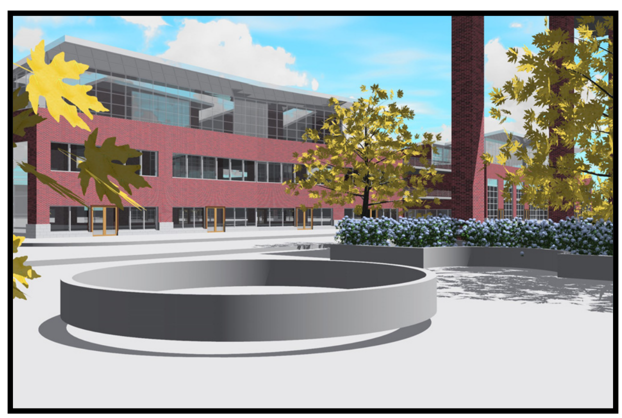
Aerial diagrammatic view of Plaza



Major proposal components

Rendering of Parking structure access tower

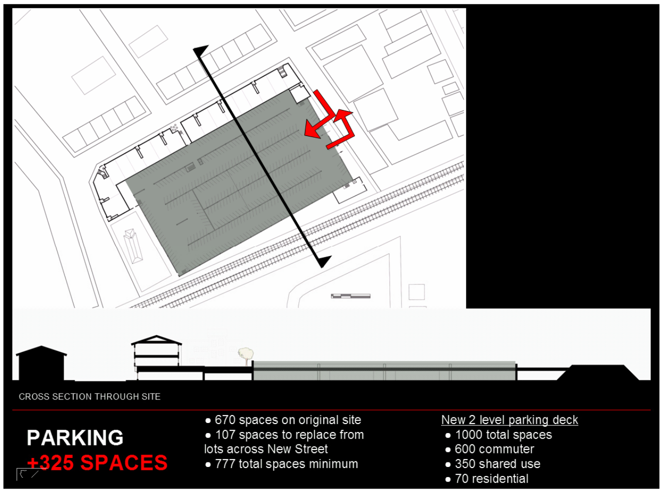
Ground level plan of proposal components



Rendering of Plaza center

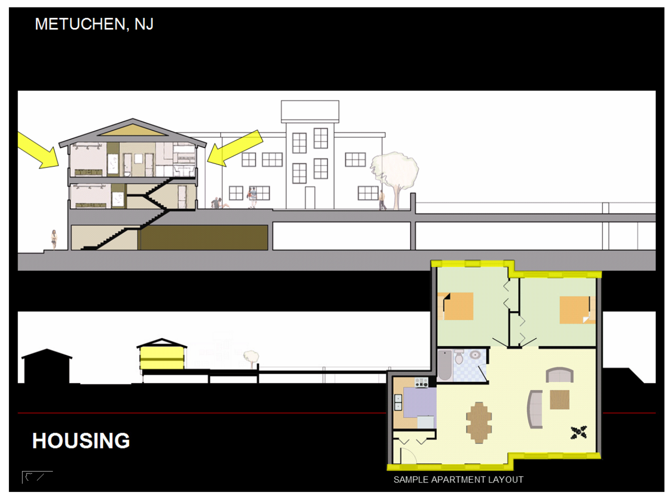
Location: Metuchen, NJ – Pearl St. Lot
Student: Michael Marmion

- Parking solution comprises one structure:
    - double helix – 5 bay including dedicated residential bay
    - 2 levels – 1,020 spaces (325 net new)
- Mixed use elements are housing and retail
- Housing (164K sf total):
    - Studio; +/- 700 - 800 sf each, 10 units
    - 1 BR; +/- 800 – 1,000 sf each, 30 units
    - 2 BR; +/- 1,000 – 1,200 sf each, 13 units
- Retail: 32 new units flanking New St, 56,500 sq ft total
- Estimated Total cost (hard and soft): $26.8M
- Estimated annual revenue (parking, res. leases, retail leases): $3.4M


CROSS SECTION THROUGH SITE
PARKING
+325 SPACES
• 670 spaces on original site
• 107 spaces to replace from lots across New Street
• 777 total spaces minimum
New 2 level parking deck
• 1000 total spaces
• 600 commuter
• 350 shared use
• 70 residential


• 18 NEW UNITS
• 40,500 S.F.
• 14 NEW UNITS
• 26,000 S.F.
RETAIL

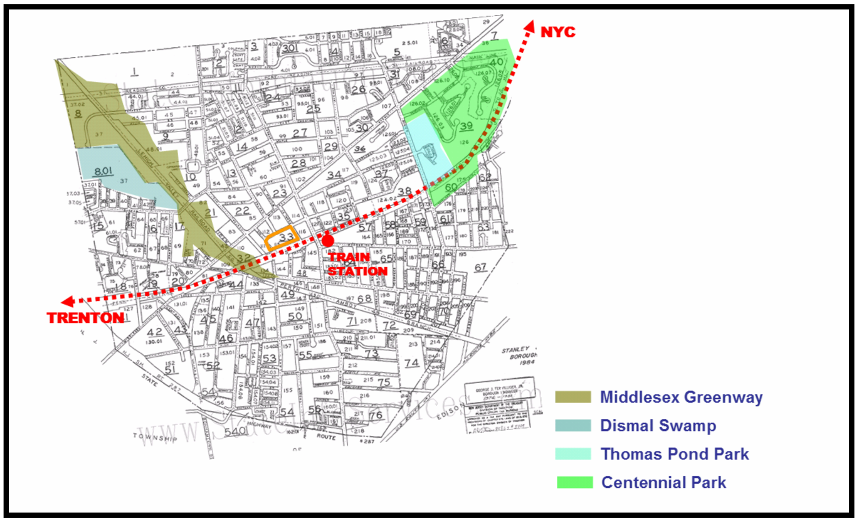

• 53 UNITS TOTAL
• STUDIO 700-800 SF (10)
• 1 BR 800-1000 SF (30)
• 2 BR 1000-1200 SF (13)
STUDIO
2 BEDROOM
HOUSING


METUCHEN, NJ
HOUSING
SAMPLE APARTMENT LAYOUT

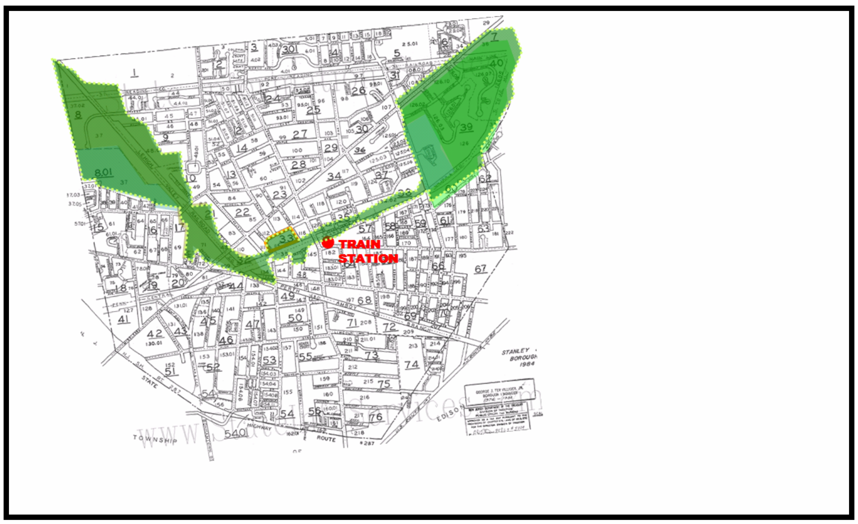

METUCHEN, NJ
PUBLIC WALK

Location: Metuchen, NJ – Pearl St. Lot
Student: Tony Okoye

- Connect surrounding parks via multi-modal greenway w/ hub at station
- Create public use space via convertible top floor of deck
- Parking solution comprises one structure:
  - single helix – 2 levels, 850 spaces (net new 180)
  - lower level – dedicated to long term and short term parking
  - upper level – dedicated to short term parking, convertible to multi-use (outdoor sports, drive-in movies, flea market, etc).
- Mixed use elements are civic (open deck and tower, greenway connector) commercial (gym) retail, and housing
- Housing (xxxK sf total):
  - Studio;
  - 1 BR;
  - 2 BR;
- Retail:
- Gymnasium:
- Estimated Total cost (hard and soft): $23.8M

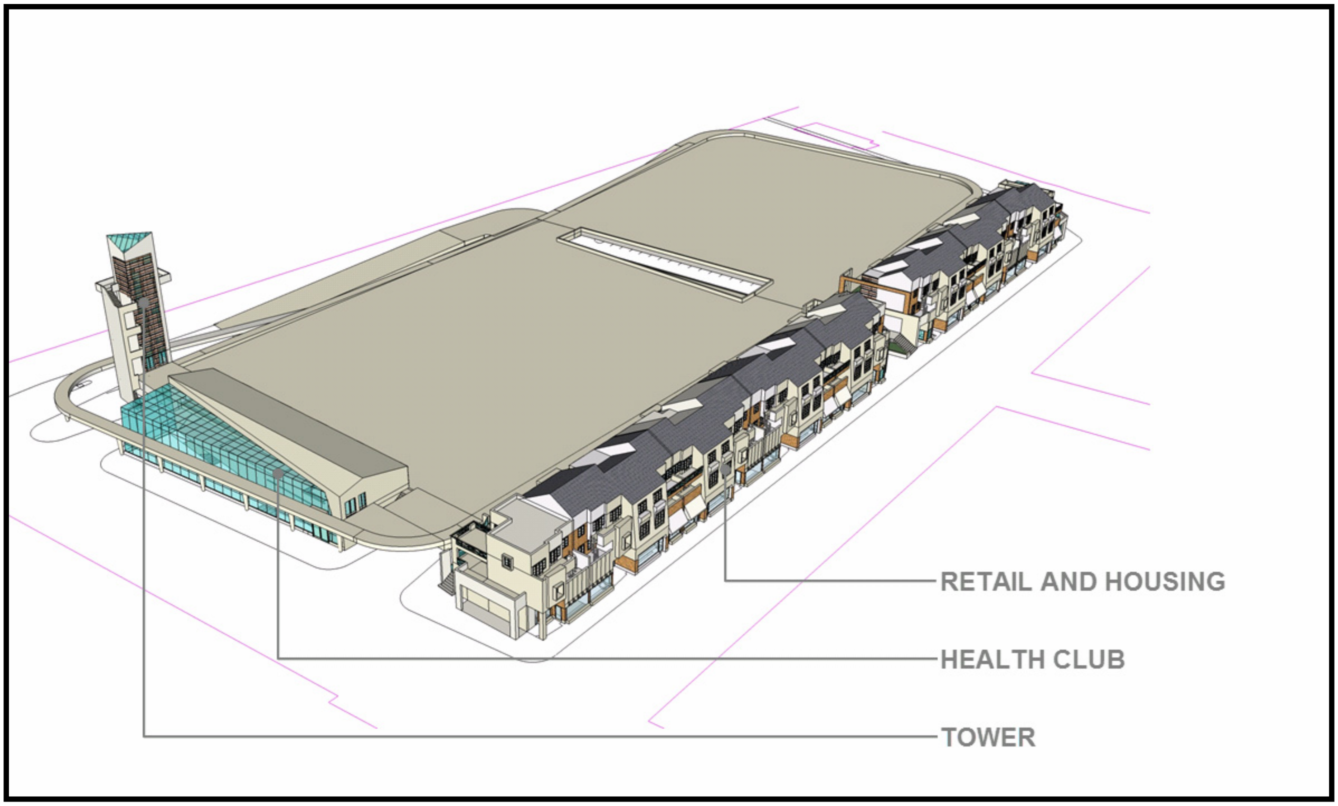


The Big Idea – Connecting disconnected green spaces

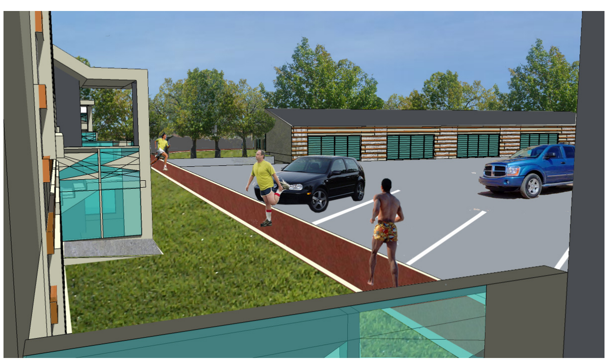


The Big Idea – one greenway, station at center

The Big Idea – Fitness/pedestrian/cycle commute path

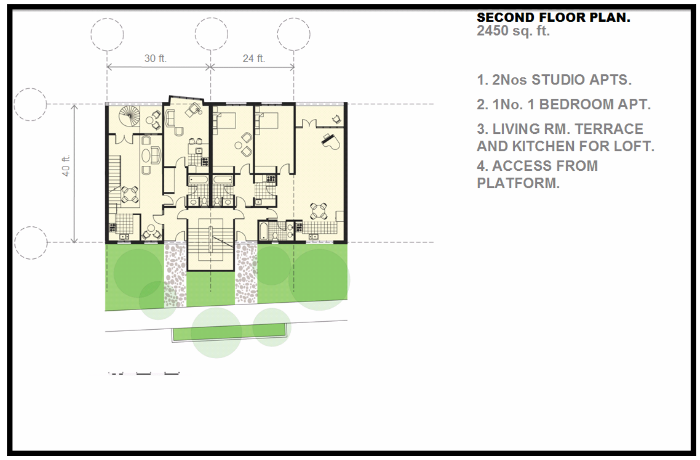


Aerial rendering from Northeast - Components of proposed solution

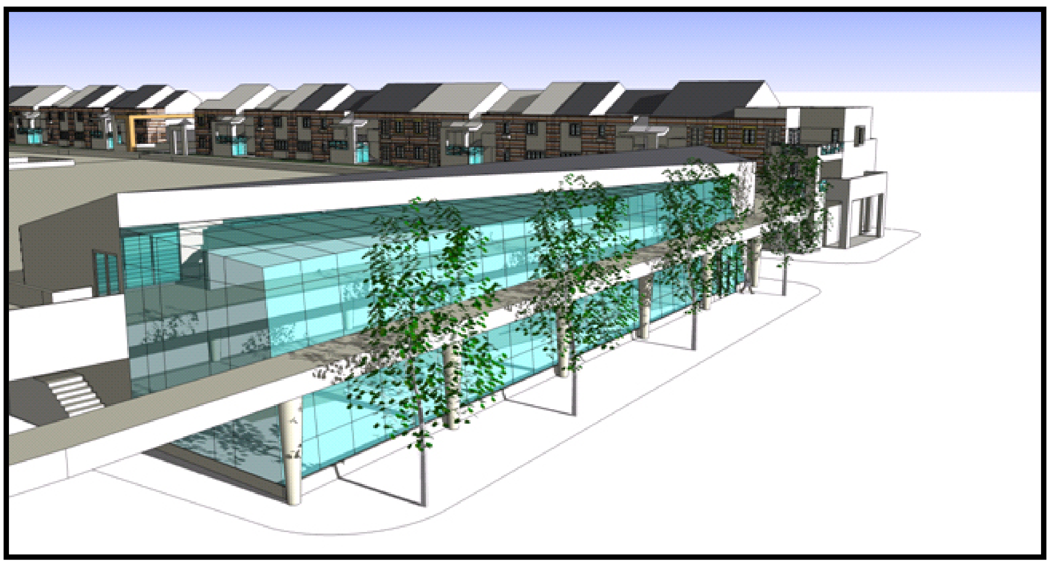


Deck convertible to alternate uses – art shows, flea market , movie night

Mixed Use – housing over retail



Typical floor plan



Health Club – destination of fitness trail

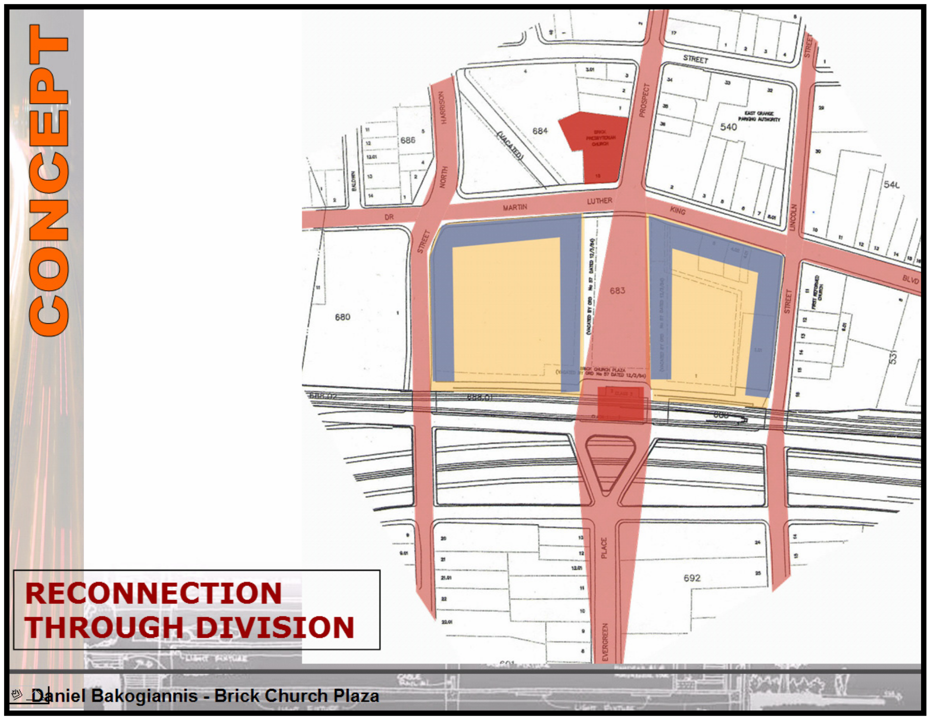
Tower: landmark, observation deck, climbing wall

Location: East Orange, NJ – Brick Church Plaza
Student: Dan Bakogiannis

- Divide site to re-estabish connection between historic Brick Church and station
  - and provide additional crossing of Rt. 280
- Parking solution comprises two structures:
  - West half –single threaded helix, plus one arm dedicated to residents

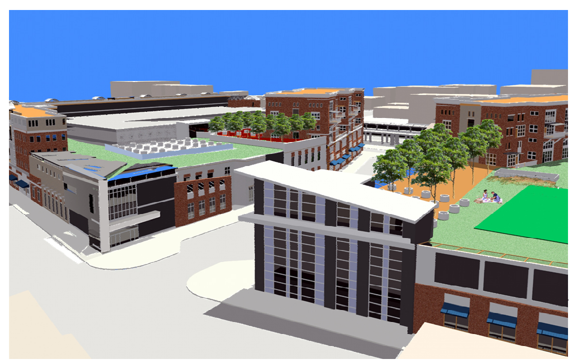
    – 1 level, 180 spaces
  - East half – single threaded helix, plus two arms dedicated to residents

    – 3 levels, 180 spaces
  - Each deck has green roof (west half total, east half adjacent to comm. ctr).
- Mixed use elements are community recreation center, retail, and housing
- Housing (xxxK sf total):
  - Single loaded 24' by 30', 45', 60' (1BR, 2BR, 3BR) – 48 units
  - Double loaded, skip-stop style 30' wide – 44 units
- Retail: existing
- Recreation center:



Site plan highlighting circulation and view corridors,
location of Brick Church and station,
and diagramming site intervention

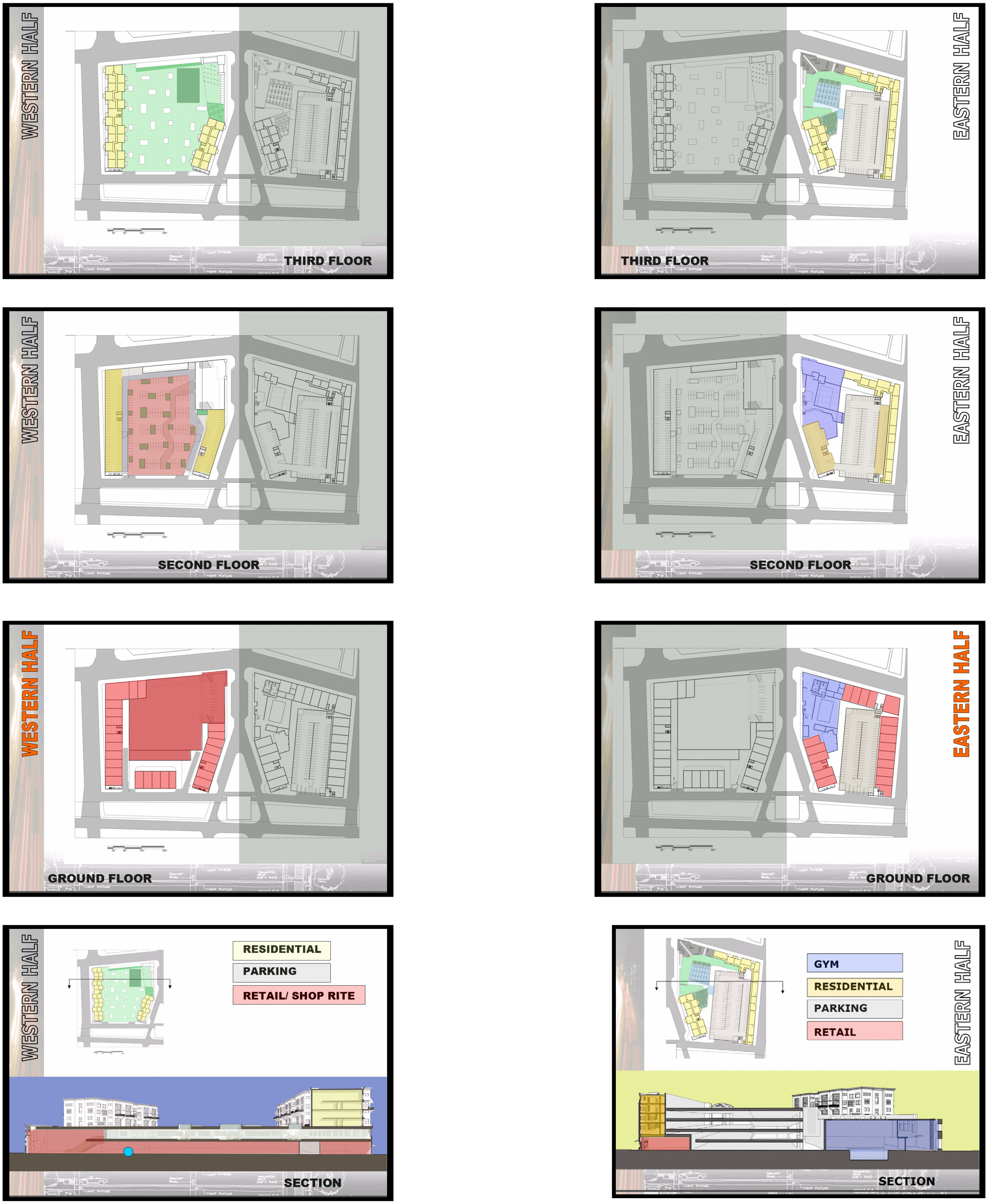
View from Rte 280 Westbound



Aerial view from Northeast

View through central plaza

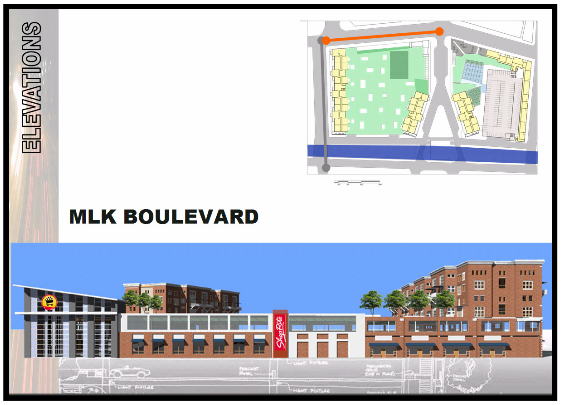
Aerial view from Northwest

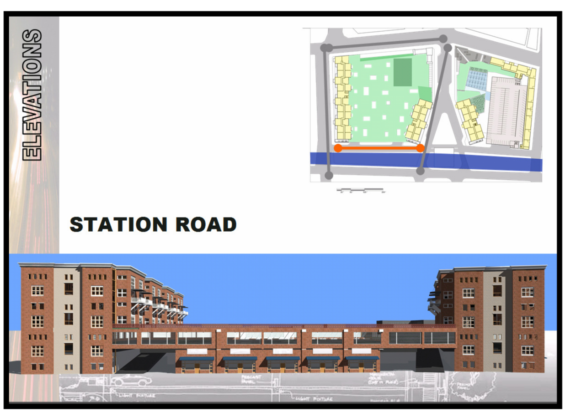


Western half

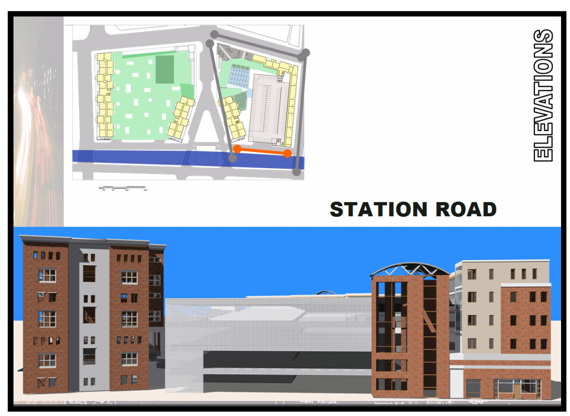
Eastern half

Programs and Sections





Western half

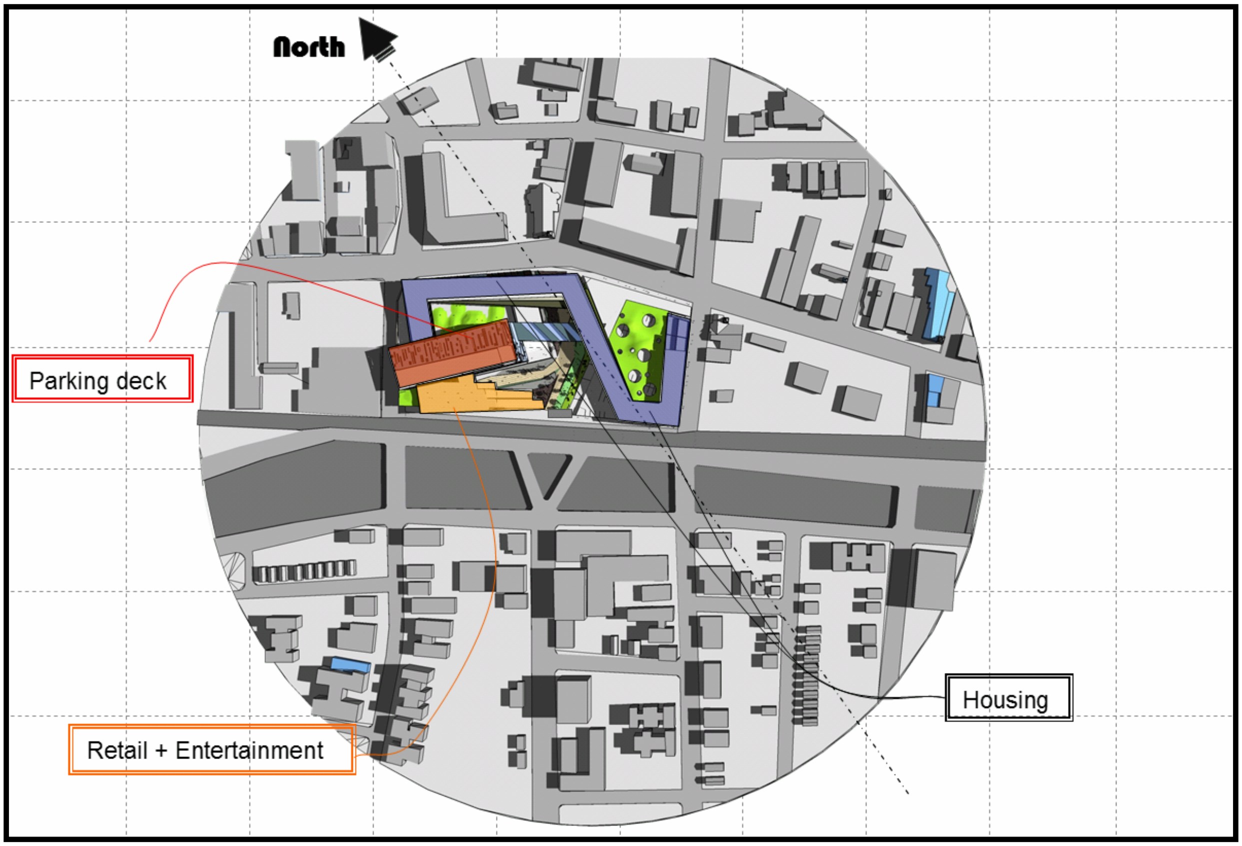


Eastern half

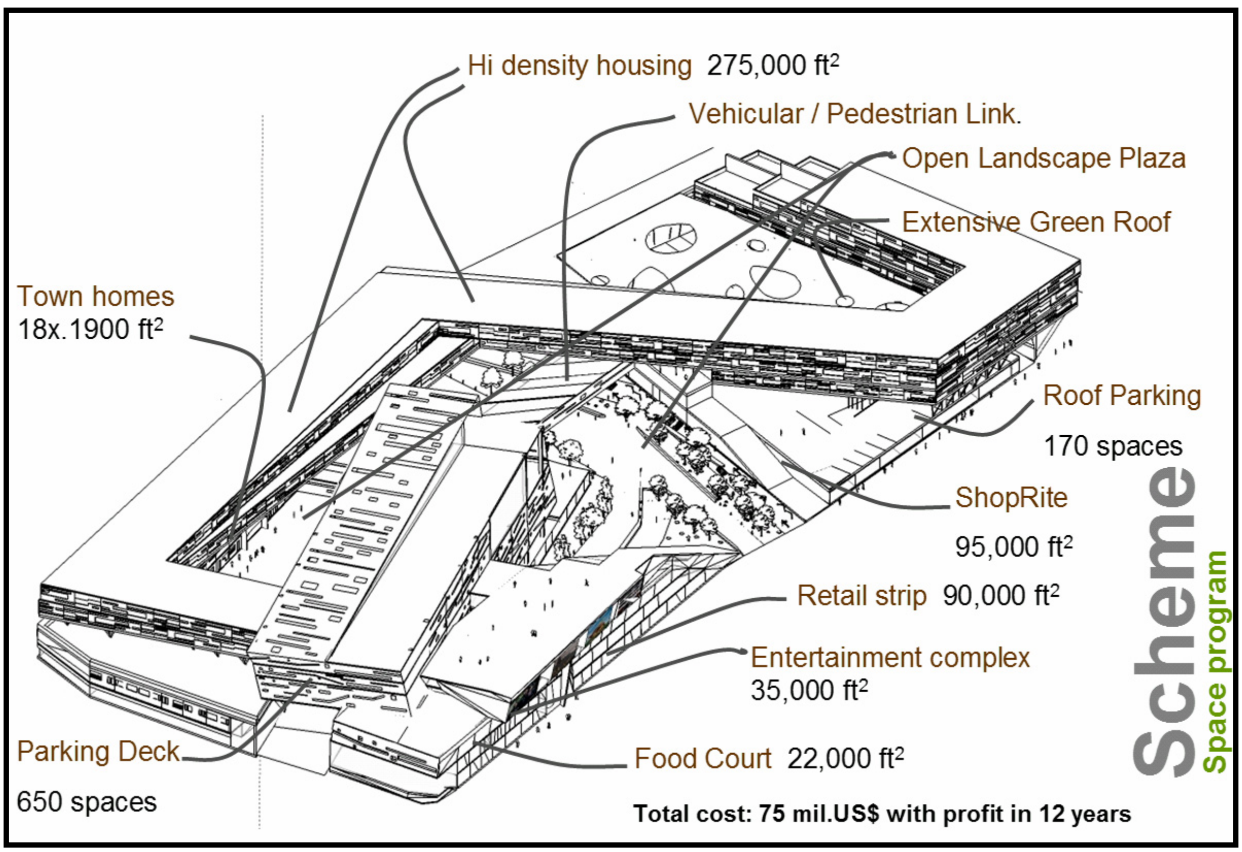
Street Elevations

Location: East Orange, NJ – Brick Church Plaza
Student: Mounir Tawadrous

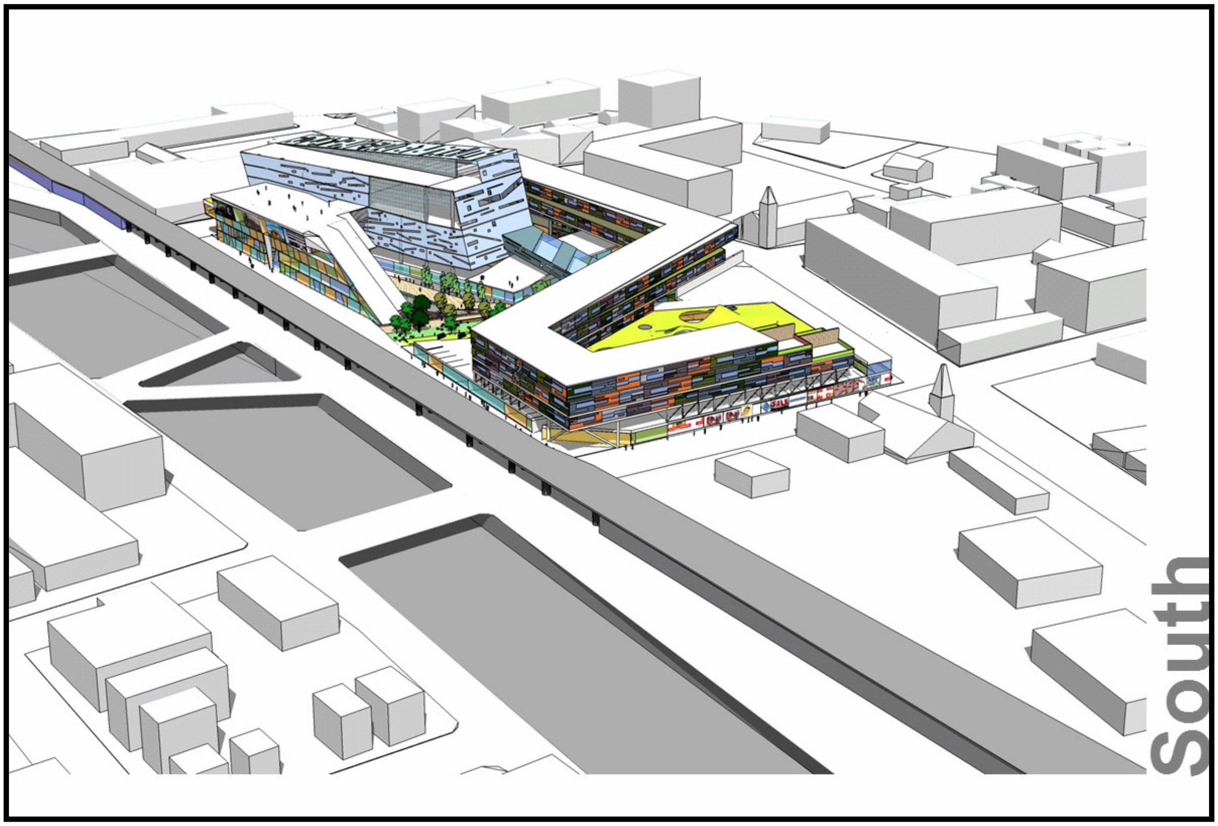
- Superblock comprising multiple elements
- Parking solution comprises two features:
  - West half - Single helix, two bays, 5 levels, 650 spaces
  - East half – one level, roof top parking, 170 spaces
- Mixed use elements are housing, entertainment complex, retail strip, food court, extensive roof garden, open landscape plaza
- Housing:
  - Townhouses: +/- 1,900 sf each – 18 units
  - High density housing: +/- 275K sq ft total
- Retail: +/- 90K sq ft total
- Entertainment complex: +/- 35K sq ft total
- Food court: +/- 22K sq ft total
- Estimated Total cost (hard and soft): $75M
- Estimated break even cash flow in Year 12



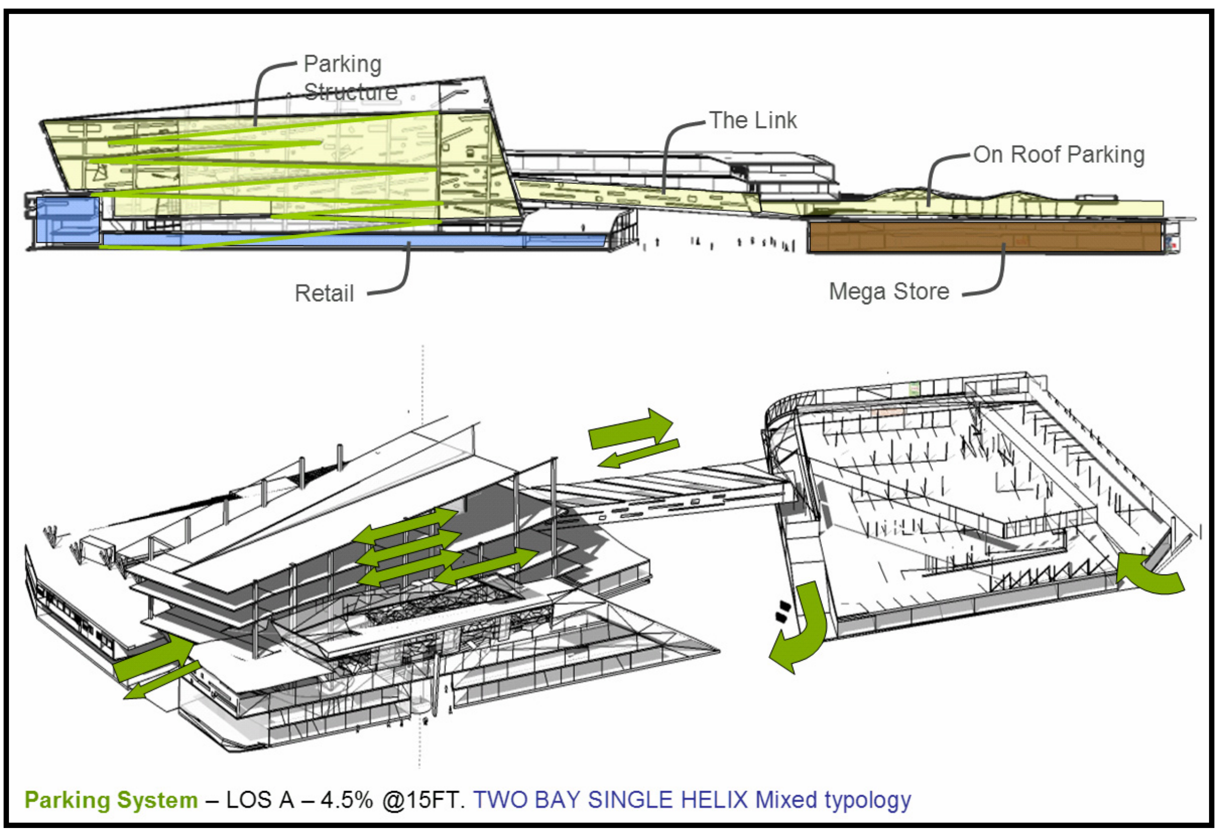
Site Strategy – major components



Site Strategy – details

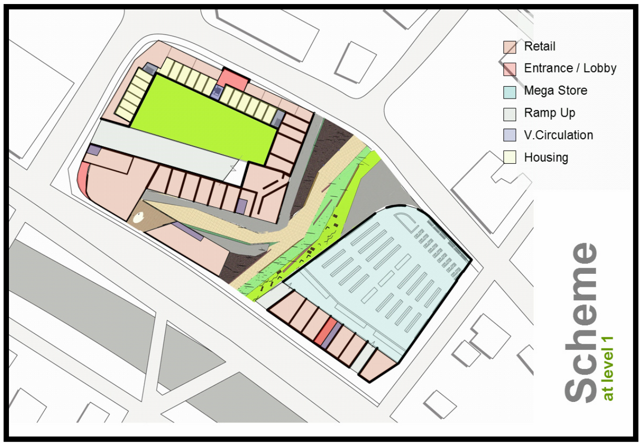


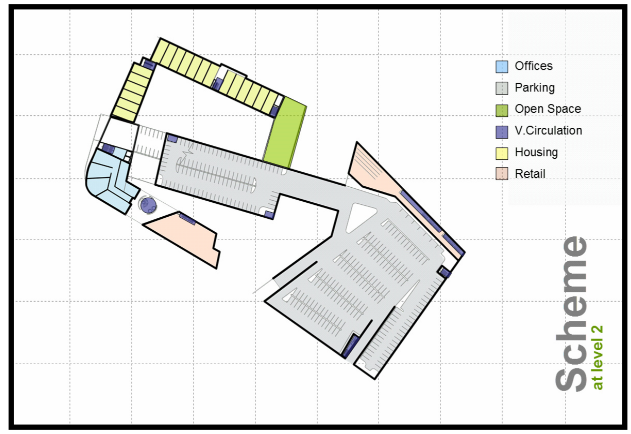
Aerial view of site - rendering

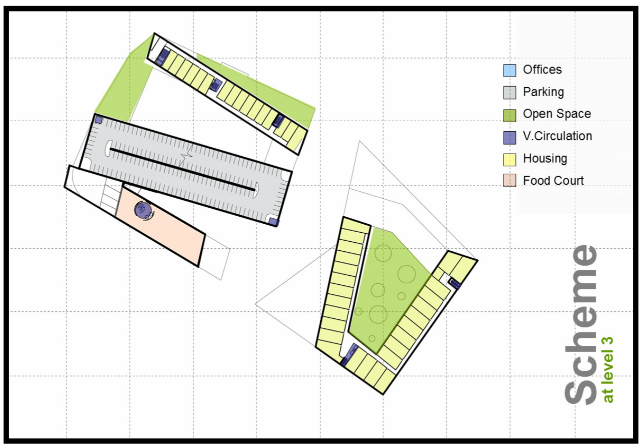


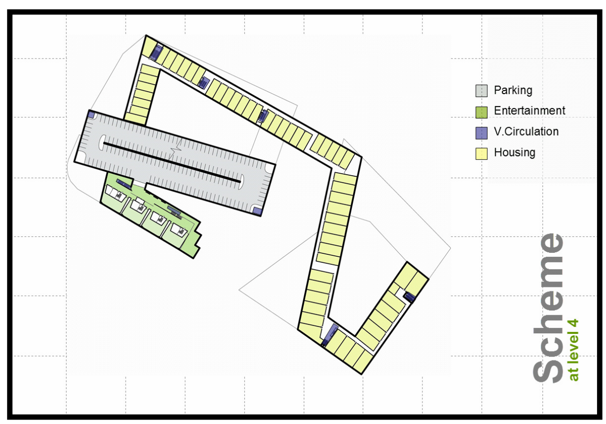
Parking strategy/development

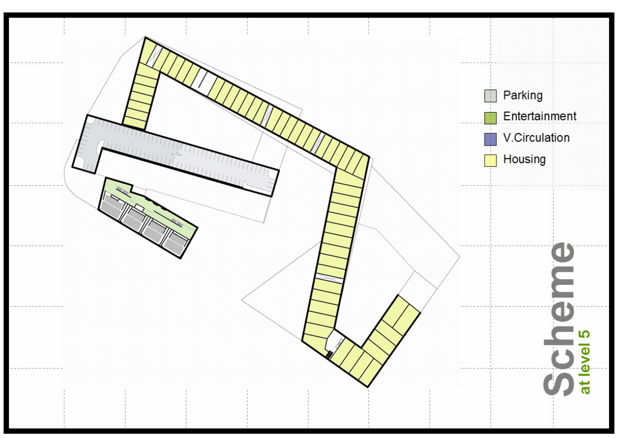
Floor Plans – diagrammatic – all levels

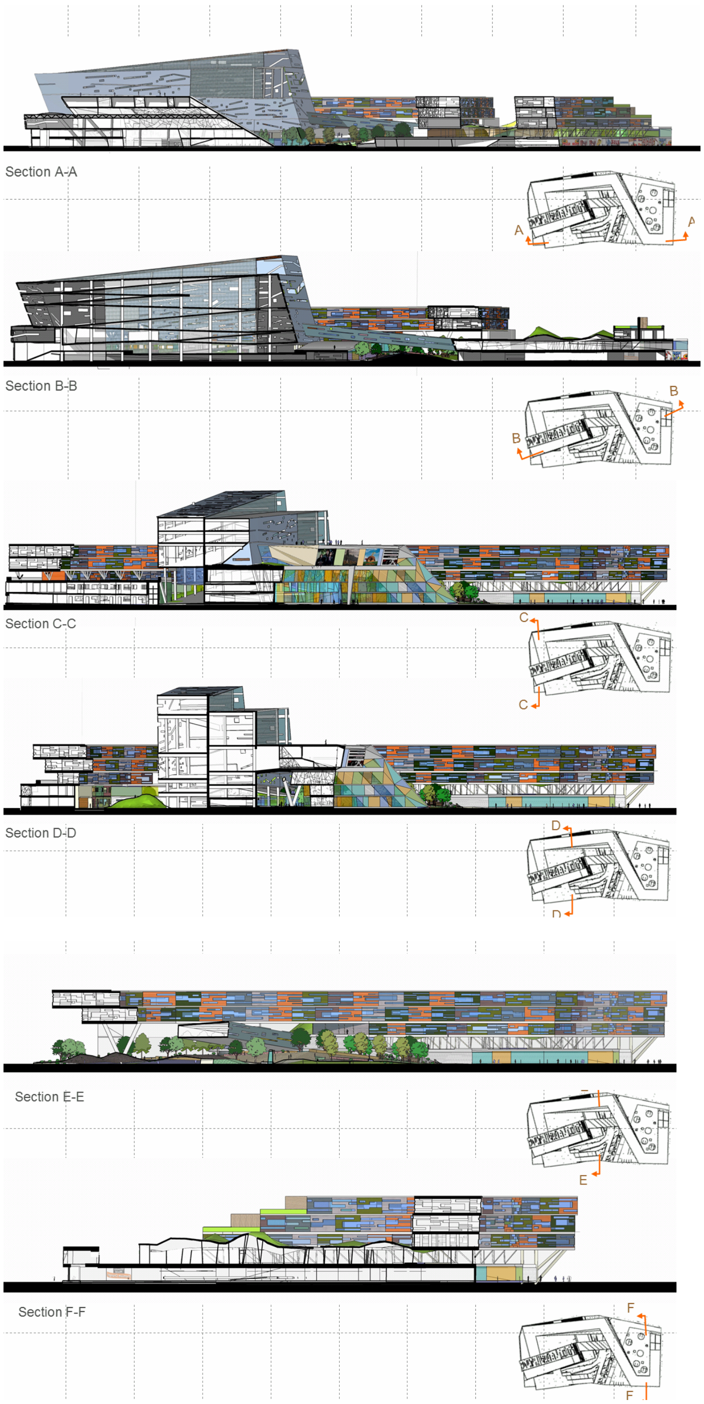




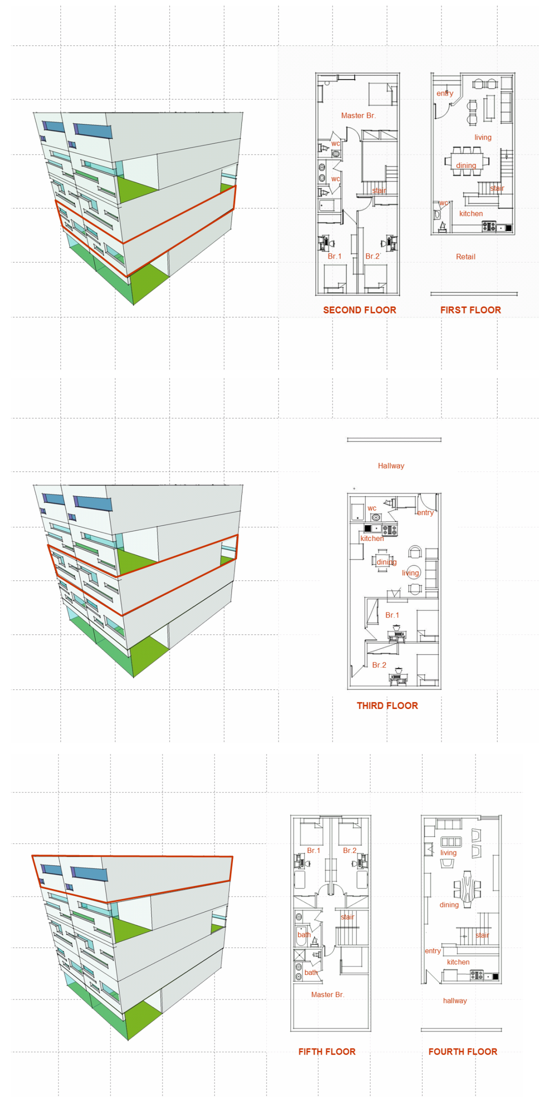








Site Sections



Housing – unit diagrams

Appendix D: ULI Advisory Services Panel

Parking Management and Architectural Development Strategies

AN ADVISORY SERVICES PANEL REPORT

September 18-21, 2005

Urban Land Institute
1025 Thomas Jefferson Street, N.W.
Suite 500 West
Washington, DC 20007-5201

About ULI—the Urban Land Institute

ULI—the Urban Land Institute is a nonprofit research and education organization that promotes responsible leadership in the use of land in order to enhance the total environment.

The Institute maintains a membership representing a broad spectrum of interests and sponsors a wide variety of educational programs and forums to encourage an open exchange of ideas and sharing of experience. ULI initiates research that anticipates emerging land use trends and issues and proposes creative solutions based on that research; provides advisory services; and publishes a wide variety of materials to disseminate information on land use and development.

Established in 1936, the Institute today has 32,000 members and associates from 80 countries, representing the entire spectrum of the land use and development disciplines. Professionals represented include developers, builders, property owners, investors, architects, public officials, planners, real estate brokers, appraisers, attorneys, engineers, financiers, academics, students, and librarians. ULI relies heavily on the experience of its members. It is through member involvement and information resources that ULI has been able to set standards of excellence in development practice. The Institute has long been recognized as one of America's most respected and widely quoted sources of objective information on urban planning, growth, and development.

This Advisory Services panel report is intended to further the objectives of the Institute and to make authoritative information generally available to those seeking knowledge in the field of urban land use.

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About ULI Advisory Services

The goal of ULI's Advisory Services Program is to bring the finest expertise in the real estate field to bear on complex land use planning and development projects, programs, and policies. Since 1947, this program has assembled well over 400 ULI-member teams to help sponsors find creative, practical solutions for issues such as downtown redevelopment, land management strategies, evaluation of development potential, growth management, community revitalization, brownfields redevelopment, military base reuse, provision of low-cost and affordable housing, and asset management strategies, among other matters. A wide variety of public, private, and nonprofit organizations have contracted for ULI's Advisory Services.

Each panel team is composed of highly qualified professionals who volunteer their time to ULI. They are chosen for their knowledge of the panel topic and screened to ensure their objectivity. ULI panel teams are interdisciplinary and typically include several developers, a landscape architect, a planner, a market analyst, a finance expert, and others with the niche expertise needed to address a given project. ULI teams provide a holistic look at development problems. Each panel is chaired by a respected ULI member with previous panel experience.

The agenda for a three-day panel assignment is intensive. It includes an in-depth briefing day composed of a tour of the site and meetings with sponsor representatives; a day of hour-long interviews of typically 15to 20 key community representatives; and a day of formulating recommendations. Many long nights of discussion precede the panel's conclusions. On the final day on site, the panel makes an oral presentation of its findings and conclusions to the sponsor. A written report is prepared and published.
Because the sponsoring entities are responsible for significant preparation before the panel's visit, including sending extensive briefing materials to each member and arranging for the panel to meet with key local community members and stakeholders in the project under consideration, participants in ULI's three-day panel assignments are able to make accurate assessments of a sponsor's issues and to provide recommendations in a compressed amount of time.

A major strength of the program is ULI's unique ability to draw on the knowledge and expertise of its members, including land developers and owners, public officials, academicians, representatives of financial institutions, and others. In fulfillment of the mission of the Urban Land Institute, this Advisory Services panel report is intended to provide objective advice that will promote the responsible use of land to enhance the environment.

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Acknowledgments

On behalf of the Urban Land Institute, the panel would like to thank the New Jersey Institute of Technology and the Alan M. Voorhees Transportation Policy Institute of the Edward J. Bloustein School of Planning and Public Policy at Rutgers University for inviting it to participate in the research process for structured parking and transit. In particular, the panel thanks Professor Darius Sollohub, Pernlla Frisk, and Anne Guiney for playing key roles in organizing the panel's time in New Jersey and assembling the briefing materials. Their countless hours of planning and preparation are truly appreciated by the panel.
The panel would also like to thank the more thank the more than 30 civic leaders and stakeholders in the communities of Ridgewood, East Orange, Metuchen, and Red Bank for taking time to meet with the panel. Their insight, experiences and candid discussion provided valuable information that was critical to the completion of the panel's recommendations.

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Foreword: The Panel's Assignment

In 2004, the New Jersey Department of Transportation (NJDOT), on behalf of New Jersey Transit (NJT), issued a task order to the New Jersey Institute of Technology (NJIT) to embark on a two-year, multi-faceted program of research, analysis, and design to better understand the relationship between structured parking and transit in a variety of communities in New Jersey. To carry out its task, NJIT assembled a multidisciplinary team from a variety of its own departments, including Infrastructure Planning, Architecture, Transportation and Civil Engineering. In addition, NJIT collaborated with the Voorhees Transportation Institute of the Bloustein School of Planning and Public Policy at Rutgers University as well as other institutions and private firms.

The project's goal is to develop design guidelines and management standards, culled from the best practices in New Jersey and around the country. These standards and guidelines are intended to serve agencies and communities in New Jersey as well as a broader audience of those interested in incorporating structured parking in a smart growth environment.

The comprehensive research includes four phases:
- Phase I: project definition;
- Phase II: assessment;
- Phase III: design-testing for applicability; and,
- Phase IV: Implementation and training.

Research to Date

The panel assisted the research at its midpoint, between Phases II and III. When the panel arrived, the NJIT led research team had studied structured parking as part of a graduate transportation planning studio taught at the Bloustein School. In the studio, three faculty led eight students in studying four communities that had either unsuccessfully attempted to build structured parking or were planning structured parking and were experiencing difficulties.

Faculty members and staff of NJT and NJDOT chose the case study communities with which the studio worked. All four communities selected were older ones that had largely developed around rail prior to WWII. All four were geographically distributed and operating along different branches of NJT's network. The Village of Ridgewood, and the Boroughs of Metuchen and Red Bank were smaller towns and boroughs with vibrant downtowns, whose residents were largely white-collar workers who commuted to Manhattan. The City of East Orange differed from the others, having a significantly lower mean income, but was also adjacent to a robust commercial district, one with several redevelopment plans in various states of development.

The Assignment

ULI was asked to serve as an independent review board at this critical point in the project, the end of the assessment phase and beginning of design testing. The panel will provide supplemental insight for the guidelines that will be developed and design tested. The panel has also been asked to give examples of how other communities have faced and addressed similar problems, recommend ways to balance traffic and density in relation to parking, and provide insight on parking garage design, mixed-use development and strategies for shared parking.

The Panel Process

Before visiting New Jersey, the panel reviewed briefing materials prepared by NJIT staff that provided information on of the research done to date and the case study cities. This material included, brief histories as well as demographic and market data and outlined each city's respective plans for parking garages within close proximity to their NJ Transit rail station. The panel spent three days in New Jersey touring and meeting with research team, civic leaders, and stakeholders in the case study communities. It then shared its findings and recommendations with the design team and stakeholders. The following is a summary of the panel's findings and observations.

Guiding Principles

After meetings and tours held in the case study communities, the panel deriveded nine principles to address structured parking in relation to transit. These guiding principles were the result of years of experience and lessons learned by the panel. They are presented to augment the research team's goal of developing guidelines for the often difficult process of incorporating structured parking within existing developed areas. The panel highlights best practices from around the country that deal with locating parking close to transit. The nine principles are as follows

- Transit adds value to the community
- Transit villages need the right amount of parking to succeed
- Graceful transition to higher density parking
- Put the parking where it's needed, not just where land is available
- Pedestrian traffic is good for you
- Shared parking-The right mix makes it work
- Good design is a good investment
- Parking management is key to success
- Devote parking revenues to parking

Transit Adds Value to the Community

The four case study communities the panel visited have two unique assets: the transit magnet that is New York City and the incredible transit infrastructure that has developed over the past century. The New York metropolitan area generates one third of all the transit trips in the United States. In the case study communities of Ridgewood, East Orange, Metuchen and Red Bank, the transit share of commute trips ranges from approximately 12.7 percent in Red Bank to 27.8 percent in East Orange. Metropolitan areas all across the country are struggling mightily and spending billions to achieve transit shares of just 5 percent of commute trips. New Jersey's high ridership is a distinct asset.

New Jersey is indeed fortunate to have extensive transit infrastructure and it is essential the communities embrace their valuable asset. Transit alone cannot eliminate traffic congestion, but transit in these communities has made a significant dent and provides another choice – a mainstay goal of smart growth. Transit is also a "locator" for development. Historically, rail enabled these communities to develop and it still can be a powerful locator for additional development and redevelopment.

Communities need to understand the value of transit and plan for its success. All too often, transit is accepted as is or ignored. Transit should be used to its full potential to provide commuters with an alternative to driving, alleviate congestion by reducing the number of automobiles on the roads, and encourage nearby development. Communities need to proactively promote transits value and use. This strategy will help to change the negative perception that transit is slow, unreliable and unsafe and will build support for future transit oriented development.

Transit Villages Need the Right Amount of Parking to Succeed

Many of the communities that are on NJ Transit lines have stations that are located in or in close proximity to their downtown. These stations provide them with the potential of serving a purpose greater than just a location where one parks and uses the transit to leave the community. The stations have the ability to connect the community with others that are along the transit line and with their immediate surroundings as well. Transit stations are a focal point for the community by generating activity in a concentrated location. To better connect the transit station with the community, planners need to incorporate a mix of uses in any station area and parking development program.

The amount of parking will ultimately drive the development program of any transit village because it will determine how many people can park near the station, the amount of retail space and the number of housing units nearby, and the overall mix of potential uses. Parking is a key element to the success of a transit village. Parking is a key element in the success of a transit village. For example, Fruitvale Village along the Bay Area Rapid Transit (BART) line in Oakland, California provides the right balance of parking for commuters, residents and patrons of the retail and commercial establishments in the transit village.

The mix of programmed uses and number of parking spaces is an important factor for the viability of a transit village. Concern about parking may seem to be a contrarian view when people are being encouraged to come to the transit village by means other than driving, but most people in the United States still commute to work by automobile. According to the 2000 US Census, the case study communities follow this trend but are below the state's average. Figure 1 shows the percentages of means of travel to work by commuters.

Figure 1. Means of Travel to Work

Community	Transit	Drive Alone	Carpool	Walk	Other Means
East Orange	27.8 %	51.0 %	14.3 %	3.6 %	3.3 %
Ridgewood	15.8 %	69.8 %	5.7 %	2.5 %	6.2 %
Metuchen	16.7 %	71.8 %	4.3 %	2.7 %	4.5 %
Red Bank	12.7 %	64.6 %	11.3 %	7.1 %	4.3 %
New Jersey	9.6 %	73.0 %	10.6 %	3.1 %	3.7 %

Source: 2000 US Census

Transit villages with a mix of uses cannot survive on the economic contributions of weekday commuters alone. They will need to draw visitors from the surrounding area seven days a week. A mix of uses that includes housing, retail, office, and entertainment space such as restaurants and movie theaters will attract uses at all times. For example, at Mockingbird Station in Dallas, Texas the developers learned that the retail portion of the project did not depend on transit to succeed; rather, access was an additional factor.

In developing a parking garage in a transit village, ensuring that there is not too much parking is as important as making sure there is enough. Requiring too much parking will cause garage size and costs to quickly escalate. Moreover, the garage will have problems fitting into its surroundings because it will dominate the streetscape. If too little parking is available, people will go beyond the parking garage and park in the surrounding neighborhoods causing problems with the community. People may also opt to drive to work and avoid public transportation all together. To avoid these problems, communities that plan on building parking garages need to carefully research and analyze their parking needs to ensure they build the right sized parking garage.

Graceful Transition to Higher Density Parking

Many communities NJ Transit villages experience parking problems. These problems have increased in the past few years as transit ridership has increased, because of better service, unbearable traffic, the increasing cost of gas, and the revitalization of downtowns in which many transit stations are located. In such communities, parking has become a critical issue, dividing commuters, residents, and the downtown business community. Unfortunately no simple solution exists.

Communities not accustomed to growth must address their parking issues with solutions usually reserved for larger cities to meet their parking demands and to more efficiently use the land that they have available. Understandably, small communities facing this problem fear that they are becoming too urban. If designed and developed correctly, parking structures can be gracefully integrated into the community to solve the transit-related parking problems.

Currently, parking demand is not being met in the available parking lots adjacent to or within a short walk of transit stations. Those lots have become overcrowded—pushing commuters to park in surrounding business districts or residential neighborhoods or avoid transit use all together. To combat this problem, communities need to transition to higher density structured parking. In many cases this is a new concept for communities and will be met with resistance. Citizens often have negative perceptions of structured parking facilities because they believe that they are expensive, unsightly, increase traffic, and are dangerous and increase traffic. In planning to introduce this new building typology to their transit station and downtown area, communities must use caution to avoid many of the mistakes that create the negative perception that parking garages are dark, unsafe, and difficult to use.

Parking garages take up a lot of space and can easily overwhelm streetscapes. During the design phase careful attention must be paid so that the structures add to the street environment and fit in with their surroundings. Design elements such as street level retail space, attractive facades, and landscaping can help integrate the structure into its environment. Because garages are often seen as a catalyst for future development, although the garage may seem out of scale, designers must envision what the area will look like in the future.

Several design techniques can accommodate a parking garage while masking its size and mitigating its impact on its surroundings. For example, designing parking structures with retail space on the ground floor is becoming common. The retail presence helps activate the streetscape and makes the walk to and from the parking lot more interesting. It creates built-in clientele for the retail uses: in transit village environments, these are filled with eateries and dry cleaners, the kinds of services that commuters patronize. Creative designers are also wrapping garages with liner buildings that contain office space and residential units to lessen the negative impact of a large structure. The mixed-use approach hides the parking and eases the integration of the garage into its surroundings. Examples of such garages are located in many cities across the United States including Princeton, New Jersey; Portland, Oregon; West Palm Beach, Florida; and Albuquerque, New Mexico.

Communities that wish to build structured parking must educate their citizens on the benefits of this new type of development. They must clearly demonstrate the current parking problems and articulate the advantage structured parking has over surface lots. They must communicate how this expensive investment will benefit the community in the long-term beyond meeting the basic parking needs.

Put Parking Where it's Needed, Not Just Where Land is Available

As communities begin to address their transit parking issues they need to set clear objectives for their station and parking facilities. They must decide if the parking structure is going to only be used for commuter parking or if it is going to be part of a larger mixed-use development. If the structure is going to be mixed-use, careful attention must be paid to the design of the garage as parking is a major factor in determining the layout of the surrounding transit station area. How the station is connected with, or separated from, the surrounding community will determine the parking requirements and development program of a transit village.

If a parking structure is intended to serve more than commuters, planners must fully understand the relationship the parking structure will have with the transit station, and the retail, residential, and commercial uses. A detailed parking study must be undertaken to determine an accurate number of spaces needed for a mixed-use development and a commuter parking lot.

Parking studies should be comprehensive to account for the commuter traffic and retail and residential users. The study should recognize that locating a mixed-use structure close to transit will affect the amount of parking needed. For example, the developer of Mockingbird station was required to build more parking than necessary because the City of Dallas did not take into account the number of users that would access the development by transit. A comprehensive parking study could have determined the correct number of parking spaces needed.

Contrary to common practice, in which parking is located immediately adjacent to the transit station, broader community goals are best met when parking is moved away from the platform. The land closest to the station is the most valuable and should be used for higher density mixed-use development. Using it only for parking is a lost opportunity.

The parking garage will need to be located a little bit farther away from the transit station than the commuters are used to. This issue needs special attention because a commuter is only willing to walk so far from their vehicle to the transit platform. This distance can be extended if they have an inviting environment to walk through. The path from the parking to the station provides an excellent area for commuter friendly retail such as a coffee shop, dry cleaners, or newsstand. Commuters can take care of daily needs and purchase goods on their way to and from the transit station.

A careful balance of distance from the parking to the station must be met so that commuters will park and use public transportation. In general, placing parking about 1,300 feet, an easy five to seven-minute walk, from the station opens prime real estate for development and does not deter commuters from using transit.

When moving the parking away from the station it is necessary that the pedestrian's path from the garage to the station be as safe and inviting as possible. To achieve this goal, the developer or the community may need to improve pedestrian amenities such as sidewalks, street crossings, landscaping, street furniture and lighting. A way finding system should also be in place to direct the commuters to the station.

These improvements should also recognize the needs of the automobile because street-traffic patterns affect the pedestrian experience. Traffic-calming measures may be needede if the streets are too busy for safe and easy pedestrian movement. These improvements are necessary to ensure pedestrian safety and make commuters comfortable with a longer walk from the garage to the transit station.

In the case study community of Ridgewood, the proposed parking structure at the corner of Walnut Street and Franklin Avenue meets a number of the community's needs. A parking structure is clearly needed to meet the demands of the popular dining and retail establishments on East Ridgewood Avenue and throughout the downtown. The structure will meet this need and also provide parking for the NJT station. Although this garage is not directly adjacent to the station, it is only a five-minute walk away. The walk up East Ridgewood Avenue to the transit station is inviting because it affords significant pedestrian amenities and an interesting mix of retail and commercial uses. The walk to the station on Franklin Avenue is not as inviting. If the sidewalks, lighting, and street crossings are upgraded, the structure will be better integrated into its surroundings.

Pedestrian Traffic is Good For You

One of the many perceptions that a parking garage conjures is an increase in traffic and congestion. This perception is false because a parking garage removes cars from the street that would otherwise be circling for an open parking space. A commuter is only willing to search for parking for a limited time before giving up and driving to their final destination.

Communities should want to capture these commuters in their parking garage because these drivers are potential customers for transit and the communities' retail and commercial establishments. Automobiles that enter a parking structure turn into pedestrian traffic as it exits the structure and walks to the transit platform. This pedestrian traffic is necessary to support retail establishments in a transit village. The challenge is to create an environment that is inviting enough to get people to stop and patronize the businesses.

In the case study communities, the panel heard about automobile traffic generated by commuters. The traffic is generally heaviest during the morning rush hour, as commuters race though the downtowns to find a parking space in the park-and-ride lots or on the streets in the immediately surrounding area. This is problematic because the parking lots and surrounding streets then sit idle for the rest of the day until the commuters return from work. This pattern creates inactive areas that do not generate enough pedestrian traffic for businesses to be sustainable because potential customers cannot find parking and decide to shop elsewhere.

For example, in Metuchen, commuters at the Pearl Street surface parking lot walk directly from their vehicle to the station platform. This direct route avoids all of the businesses near the station on Main Street. If this surface parking lot were to be developed into a mixed-use structure, the commuters could be directed to walk down Pearl Street to Main Street. This pedestrian traffic would activate the street and encourage commuters to patronize the businesses along Main Street.

This commuter traffic is good for the development of a mixed-use parking garage. It is a built-in and established customer base for the transit village's businesses. These businesses need this base but they cannot survive on it alone. Their success is also dependent upon traffic that is generated by people coming to transit village to patronize the retail and commercial uses available in during the day and in the evening and weekend hours.

People also arrive at the transit station by foot and on bicycles. This type of traffic will increase as a mix of uses is incorporated into the station area. Communities need to provide amenities, such as better lighting, crosswalks, landscaping and way finding systems to further attract pedestrians and ensure their safety.

Shared Parking-The Right Mix Makes it Work

Construction of parking in a downtown is expensive. The typical downtown has very little land available to add additional parking, or the available land is currently used for surface parking lots. In either case the cost of adding parking in a downtown is usually over $10,000 per space if new surface lots are constructed through property acquisition and demolition. To add structured parking over an existing surface parking lot, the typical construction costs are $15,000 to $20,000 per parking space for the structure.

An added difficulty is that it requires the relocation of existing parking during construction. Special attention should be paid to the duration of the construction process to minimize the inconvenience to the commuter and the impact it has on the surrounding businesses. In many small downtowns a three to four level parking structure is as tall as it is appropriate. With such a small garage the existing on grade parking spaces must be reconstructed. This results in a typical cost per added parking space of $20,000 to $30,000 since the reconstructed spaces do not add to the parking supply.

Because of the high cost of building structured parking, a mix of uses can, and should, utilize the parking over as many hours per day as possible. As expected, many complementary uses peak at different times of day or week. If development opportunities are foundthat complement each other, the added spaces can be used by many users over the course of the day. The panel believes that the proposed structures in all of the case study communities are ideal for shared parking arrangements between NJT and the surrounding retail and commercial establishments.

Figure 2 summarizes major uses that peak during the day compared with those that peak at night and on the weekends. Commuters and office uses are compatible with entertainment, restaurants and special events because their intended use times are at different periods of the day. The type of office use will also determine the frequency of parking space turnover. For example, a doctor's office will have a higher frequency of visitors as people come for scheduled appointments than a law firm where there are only a few visitors.

Figure 2. Complimentary Shared Parking Uses

Daytime	**Nighttime/Weekends**
Commuters	Entertainment/Events
Office	Retail
School	Restaurants
Deli/Fast Food	Hotel
Residential	Residential
	Churches

Residential parking is a more difficult issue when it is located adjacent to transit stations. Residential users in transit villages are likely to only own one vehicle per household and to use transit to commute to work. The occupancy of these spaces remains high most of the day because these users do not use their vehicles. The lowest occupancy of these parking spaces is during the evening hours and weekends, when the residents return and use their vehicles to run errands and make other trips by vehicle. To complicate matters further, many residential developers insist on reserving residential parking 24 hours per day, so shared uses are not possible. A solution to this problem is providing valet parking for both the residents and commercial users. This technique allows users easy access to their intended destination and allows the efficient use of the parking garage.

The occupancy of each use group in Figure 2 varies throughout the day with a reasonable mix of heavy daytime and heavy night time use. By working with a developer, a design team should identify a mix of uses that optimizes the use of a structured parking garage. In this specific study the commuter parking tends to dominate uses in communities with rail stations; however, planning and zoning requirements should be modified to take advantage of complementary uses. In so doing, the expense, size and architectural impact of added parking is minimized because the parking is sized based on peak occupancy rather than according to tradition zoning requirements that assume all parking peaks occur at the same time of day.

Good Design is a Good Investment

The construction of a parking structure is an expensive investment for any community. Incorporating a garage into a transit village requires special attention in planning and design. The garage must be in context and fit in with its surroundings. It must integrate with the neighboring buildings and not overpower the streetscape. The structure should incorporate local architectural styles and reflect the character of the community. Meeting this requirement is difficult as parking structures are large and often unsightly; nevertheless, many design techniques can be applied to lessen the structure's impact. Designers can include materials such as brick on facades to match surrounding builds, add faux windows, grow ivy to break up large dead spaces in the facade, or wrap the structure with liner building that incorporate a mixture of uses.

The design of a parking structure that is incorporated into a downtown or transit village must show greater sensitivity than that of a regular parking garage. Because of the added design features, a mixed-use parking structure typically costs more to build than a conventional parking garage. As noted in the previous principle, the cost per space of construction can range from $15,000 to $30,000. Adding parking to an existing downtown area, however, can substantially increase the value of adjacent properties that are served by the parking. A portion of the increase in property values needs to be captured and used to help fund the parking.

A Tax Increment Financing (TIF) district can be used for this purpose. TIF districts can be very useful in developing parking where strictly private financing might be difficult to obtain. The money that is generated from the TIF district can be used to pay for the parking or enhance pedestrian amenities such as lighting, way finding, and street crossings. TIF money can also be used to offset the land acquisition and infrastructure costs in new parking structure development. A well-designed parking structure that integrates with its surroundings will help to foster a sense of place and provide lasting value for the community.

Parking Management is Key to Success

A good parking management program is a key element of a successful downtown. A management program for the sake of just providing parking spaces is not enough. It must be flexible, continually balancing the demand for parking with the existing supply. Managers must be able to teach communities about their parking patterns, and the best way to react. They must be able to identify trends and react quickly.

For example; a downtown commercial block in the Village of Ridgewood last year had a retail mix last year of 50 percent restaurant and 50 percent retail. This year that same block now has 70 percent restaurant and 30 percent retail. The parking program needs to respond to this change by adjusting rates, time zones and enforcement to better manage the change in uses.

Many communities develop deficiencies within their systems such as the previous example. If enforcement does not change the laws governing parking from 5pm to 10pm, then every restaurant employee that works in the area will fill the on-street spaces by 5:15 pm. This issue will negatively affect the restaurant patron's experience because they will not be able to park in the spaces that are intended for them and will have to search for an open space.

A tool that communities often used to manage parking is permit parking. These permits can be issued for residential neighborhoods, the central business district, and the train station. Such a program can be effective if run properly. Unfortunately many programs are oversupplied, and the community has difficulty understanding what it really needs for each program.

For example; Ridgewood issues 900 resident permits for 300 resident parking spaces. How does the Village know the number of spaces being used and when? From a verification standpoint, the only control used in this program is whether the tag is current for the year it is issued for. This system does not provide the vital details necessary to make this program successful; it gives little indication how many spaces are really needed to support it.

The panel noted that most of the communities it visited were using parking equipment that only accomplished the minimum of tasks, basically maintaining parking. Far better, technologically advanced equipment is available that will allow communities to understand their parking patterns and space needs. Such upgraded equipment and permit programs will give communities better data with which to make decisions.

Multi-bay meters are an example of technologically advanced parking equipment . These meters serve more than one parking space. They are often located in a central location within a parking lot, garage, or street. Patrons park in a numbered space and then pay for parking at the multi-bay meter. The meter then issues a receipt that is to be placed in the vehicle. The meters accept coins, cash, and credit cards. Multi-bay meters can help communities manage their parking better because they can collect valuable data such as the average length of stay for a vehicle, the frequency of turnover per space, and the average revenue per car. They can also be adjusted to charge different rates during different time of the day or week.

Another technology that can be used to better manage the resident parking program is bar coded parking permits. A bar coded parking permit is linked to a specific vehicle and can be scanned when it enters and exits a lot or garage. By scanning the bar code, information such as the average length of stay; the number of cars parked each day, week, or month; and the distance the car travels can be collected. With the information gathered from bar codes, a community can determine how often resident permits are being used and can set programs and policies to effectively use the available spaces.

Devote Parking Revenues to Parking

Nobody likes to pay for parking. Many people feel that a free and convenient parking space is a birthright. Citizens find it a hassle to find change to deposit in a meter. Local merchants don't like paid parking because they believe that it will drive business away; neither do they like the appearance that there is no parking in front of their business. In these circumstances, parking management becomes a necessity, but many communities have neglected the time and resources to meet the parking needs of its citizens and the business community.

By neglecting this critical issue, many communities treat parking as a "step child," passing responsibility from one city department to another. Most cities do not have trained parking managers. The panel saw parking operations managed by a wide variety of departments such as the city controller's office, police department, parks and recreation department, and the maintenance department.

The revenue generated from parking fees and fines is often put into the general fund instead of into a parking program. This practice is flawed because it does not address the parking problems of the merchants or the users of the parking spaces. A successful parking program requires that parking revenue is dedicated to the parking program. This constant source of income should be used to fund future capital projects and address parking problems within the community. Revenues can come from parking meters, monthly parking permits, and parking ticket collections. The money that is generated can be used for upgraded meters and pay stations, streetscape improvements such as landscaping, street furniture, lighting and way finding systems, and clean and safe programs. Merchants will clearly see the benefits to paid parking and their doubts will be alleviated when they the community commits to dedicate all of its parking revenues to the parking program.

If the parking revenue is still not sufficient to cover capital needs, then communities can consider several other options. Public/private partnerships are often used to finance and build parking garages. Financing structures for public/private partnerships are as varied as the developments themselves. Typically, the public sector provides the land while the private sector builds the garage. The two entities then share the parking revenues. In the case of mixed-use garages, the public sector can sell the development rights for the liner buildings and ground floor commercial space to help finance the construction of the structure.

The private sector can also solve parking problems. If available land and significant demand for parking exist, private companies can build and manage garages, particularly if the site has the potential to include a mix of uses in addition to the parking garage. The developer will then be able to use the parking spaces for more hours of the day with greater efficiencies, thus generating more revenue.

Conclusion

The panel has provided its best professional opinions to address incorporating structured parking in developed areas along transit; however, the panel realizes the hard work of implementation and solving this challenging problem remains with the local communities of New Jersey. The solutions are multifaceted, they are not short term, and they require constant monitoring and vigilance to determine what is working and what is not. Changes in transit ridership and the real estate market will likely require changes to policy. The guiding principles provide communities facing this challenge with a framework from which to begin the planning process. The panel believes that if these principles are followed, local municipalities will be able to successfully integrate structured parking and creat transit-oriented development in their communities.

About the Panel

William (Bill) R. Eager (Chair)

Seattle, Washington

William Eager is co-founder and President of TDA, Inc. He has more than 40 years of experience in the transportation field as an educator in transportation engineering, in the research of commuter travel characteristics, and as a consultant on projects throughout the United States and abroad.

Before founding TDA, Eager was Vice-President of Transportation for a large economics consulting firm and, earlier, was responsible for analysis of ground transportation systems for the Boeing Company.

Eager is a member of the Pacific Asia Travel Association (PATA) and Principal of INTRA -- International Tourism and Resort Advisors. He is a longtime member of the Urban Land Institute (ULI) where he was a Trustee for seven years and currently serves on the Public/Private Partnership Council as an honorary member.

Robert Dunphy

Washington, DC

Robert Dunphy is Senior Resident Fellow, Transportation at the Urban Land Institute. He created ULI's program of transportation research and has been responsible for the Institute's research, books, conferences, public policy, and public outreach on transportation and land use, transit, and parking.

In his previous role, he directed studies of seven large regions recognized for their efforts at implementing consistent regional transportation and development policies, reported in his book *Moving Beyond Gridlock: Traffic and Development*. He is the author/ project director of numerous books including *Residential Streets; Dimensions of Parking; Parking Requirements of Shopping Centers,* and *Transportation Management Through Partnerships*, - as well as a forthcoming book on transit oriented development, and the transportation chapters in *Implementing Smart Growth at the Local Level*, and *Transforming Suburban Business Districts*. In addition, he created "Myths and Facts About Transportation and Growth", a popular brochure which presented hard facts on-often soft issues and became the first in a series.

Dunphy has collaborated on a number of studies of national interest. For the Federal Transit Administration, he directed, in partnership with the Texas Transportation Institute, the development of land use criteria for new transit systems, which are now being used as part of the federal approval process. Also for FTA, he teamed with the University of California for a series of workshops on the development of real estate adjacent to transit facilities.

He has directed ULI outreach efforts in Atlanta and Charlotte intended to engage the development community in a dialogue on strategies for implementing transit oriented development. He directed ULI forum on balancing land use and transportation, which brought together a wide range of leaders active in local real estate, traffic, transit, and parking concerns from across the U. S. He organized ULI's first conference on technology and real estate and has directed national and regional seminars on transportation and growth, joint development, and landfill siting.

Dunphy is active in national committees of the Institute of Transportation Engineers and the Transportation Research Board, for which he chairs the Transportation and Land Development committee. He is a member of Lamda Alpha International, an honorary land economics society. Dunphy is a frequent speaker on issues of transportation and smart growth, transit related development, and parking to national and local groups including ULI District Councils, business and leadership organizations, transit associations, and government agencies. He served on Maryland's Transportation Solutions Group, organized by Governor Parris N. Glendening to advise on a controversial suburban highway proposal.

Reed Everett – Lee

Fort Lauderdale, Florida

Reed Everett-Lee has been with Carter & Burgess for over five years. For the last two years, he has led the development and expansion of Carter & Burgess's transit practice in South Florida.

Prior to joining Carter & Burgess, Reed was Manager of Systems Planning for VIA Metropolitan Transit in San Antonio, Texas. Before going to San Antonio, he held the position of manager of Corridor and Environmental Planning for Dallas Area Rapid Transit (DART) and was project manager for DART's Southeast Corridor Major Investment Study. Before returning to DART, he was Principal Analyst in the Market Development Division of the Regional Transportation Authority (RTA) in Chicago. While at the RTA, he was responsible for policy development and analysis, and project management of the RTA's Transit Oriented Development program including the formation of the RTA's Regional Technical Assistance Program. The RTAP, now in its seventh year, has provided technical assistance for Station Area Planning, County Transit Plans, Corridor Studies and Technology Initiatives for 29 communities in the Chicago Metropolitan region.

Everett-Lee holds a Ph.D. and masters degree in anthropology from Southern Methodist University, and a bachelors degree in sociology and a masters degree in city and regional planning from the University of Texas at Arlington. He is a member of the American Institute of Certified Planners and the American Planning Association.

Greg Stormberg

Nashville, Tennessee

Greg Stormberg is the Executive Vice President for Central Parking Corporations where he has held several leadership positions since joining the company in 1995. Stormberg's offices are located in Nashville, TN where the company's headquarters have been located for over 35 years.

During his 21 year career in the parking and transportation industry, Stormberg has been involved with numerous projects including transportation corridor agency toll roads of Orange County, CA, privatization of Bush Intercontinental and Hobby Airports Houston, TX, multi-level garage development at Louis Armstrong International Airport New Orleans, LA, Astrodome Houston, TX, Toyota Center Houston, TX, University of California Irvine Medical Center Irvine, CA and Eisenhower Medical Center Rancho Mirage, CA Along with the previously mentioned facilities He has also worked on many projects that are helping pave the way for the advancement of technology applications within the parking and transportation Industry.

In his current role Stormberg has direct responsibility for several area of the United States that include New York, Los Angeles, San Francisco, Atlanta, Miami, Arenas and Stadium Division, Airport Division and Toll Road Division. His entire area encompasses several hundreds of properties and in excess of 10,000 employees.

Stormberg serves on the ULI Entertainment Council (EC) and previously served as Vice President for the Texas Parking Association. He is also active in several other organizations such as Building Office Management Association (BOMA), International Downtown Association (IDA), International Bridge, Turnpike and Toll Association (IBTTA), National Parking Association (NPA) and International Parking Association (IPI).

David Vanderwal

Boston, Massachusetts

With Walker Parking Consultants since 1986, David Vanderwal serves as Senior Project Manager for major projects throughout the United States and internationally. During his time at Walker he has been personally responsible for the design of over 50 parking structures. He is experienced in parking planning, design and construction engineering administration of new parking facilities, and restoration design for existing parking facilities.

Currently Vanderwal is the lead functional designer for the 7,500 space parking structure for Block 35/36 in New Songdo City, Korea; 2,500 space Central Park parking structure, New Songdo City. Other representative parking structure projects Dave has designed include the Morgan Stanley underground garage, Purchase, NY; Walter Street parking structure, Springfield, MA; Sempra Energy, Stamford, CT; and the Fortunoff parking structure, White Plains, NY. Other functional consulting assignments include parking structures for Albany Airport, Albany, NY; Park Central, Las Vegas, NV; Oyster Bay, Syosset, NY; City Center; Salt Lake City, UT; and Waterside Place at Pelican Bay, Naples, FL.