THE UBIQUITOUS PARKING STRUCTURE – IT'S TIME FOR A REAPPRAISAL

by

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ABSTRACT OF THE DISSERTATION

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Structured parking is a key component of urban, suburban downtown, and exurban clustered developments in every metropolitan area across the United States. Due to the complexity of the redevelopment process itself, as well as its engagement of many stakeholders and decision-makers from the public and private spheres, the process does not reliably produce a holistic, aesthetic and integrated parking program that fully serves its context and users. The overall process of redevelopment is impacted as well, and this dissertation delves into the potential advantages from the design, development, and financial perspectives for getting the parking program right.

Standards and measures for improving structured parking that are situational and case-specific may not reflect user preferences, nor can situational standards consistently lead to improved outcomes for the redevelopment project as a whole. This is especially true when a range of demographic and social trends—including generational shifts, evolving technologies, and changing settlement patterns—are reducing rates of private vehicle ownership and use, and in tandem potentially reducing parking demand.

This dissertation demonstrates that by focusing on five key design criteria common to all structures—size, scale, massing, visual representation, and placement—

the performance of structured parking can be enhanced. The standards derived from these criteria, in conjunction with guidelines drawn from architectural and urban design literature, can serve to improve both structured parking and the redevelopment's overall quality and tenor. The findings of this dissertation can be used to enhance the redevelopment public policy framework and dialogue.

The dissertation utilizes multiple methods from both social science and design research: surveys and assessments based on census and direct sources; financial pro formas; iterative development of prototypes of structured parking; Visual Preferences Surveys™ to test user preferences of the prototypes in a range of development contexts; and interviews with officials and executives engaged in parking and redevelopment decision-making.

The dissertation's final deliverables include: (a) best practice models of structured parking; (b) model regulatory guidelines for both freestanding parking decks and integrated structured parking in mixed-use settings; and (c) implementation standards and strategies. These recommendations are drawn from the survey responses and qualitative input of users, professionals, and public policy experts, and support from traditional urban design and planning standards. The structured parking standards are based on an understanding of the forms this building type has assumed over time, and the various traditions in urban and city building to which these models and standards apply, while maintaining a forward-looking consideration of possible future changes in vehicle ownership and use.

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This dissertation is dedicated to my wife Lynn

and my sons Robert and William who have

supported me throughout the doctoral journey.

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CHAPTER 1. INTRODUCTION AND HIGH-LEVEL FINDINGS

Structured parking is a critical feature of development and redevelopment zones. In the words of Robert Goldsmith, Esq., a New Jersey land-use attorney with decades of tenure leading redevelopment programs and advising parking authorities, parking is "oftentimes the first public act in a redevelopment context and sets the stage. Redevelopment authorities who ignore the importance of getting the parking program right, do so at their own peril" (Goldsmith 2019). Goldsmith continues, "Like sewer and water, it just isn't sexy. But try to get a bank to finance without it and it just won't happen. It's so basic, and yes, so ignored".

Despite this foundational role, parking structures are not uniformly held in high repute. Structured parking is typically developed in response to an existing, anticipated, or new demand for density, with cost and market demand frequently serving as a primary driver in decision-making. During development, the parking structures are more often treated as an extension of automobile infrastructure than as structures for human use. As Simon Henley described, "Once the icon of modern city planning, the height of convenience and efficiency, the car park has been largely related to urban blight. Its formal isolation from neighboring buildings, and its ability to isolate one part of the city to another is hard to condone" (Henley, 2007, p. 15).

Sensitive to the parking structure's lack of standing as a building type the National Building Museum in 2010 launched a traveling exhibit entitled "House of Cars: Innovation and the Parking Garage." This exhibit explored the origins and utility of the parking structure in the American urban context. Originating as an accommodation for

ladies' downtown shopping trips in the 1920s, garages became massive mid-century constructions supplemented with federal funds and armored for alternate use as bomb shelters. The National Building Museum exhibit addressed both built and unbuilt proposals as well as a series of recent structures, some of which are examined in the current dissertation.

Referring to the National Building Museum's exhibit, writer and reporter Louis Jacobson remarked in Washington DC's *The City Paper*, "No matter how many historical photographs and captions you provide, no matter how earnest the archival newsreels, you're left with a whole lot of mundanity" (Jacobson, 2010, p. 1). In the assessment of National Public Radio's *All Things Considered,* "While the exhibit includes some ardent efforts at design, a parking garage is ultimately a parking garage. It's more likely to be an eyesore than a sight for sore eyes" (National Public Radio, 2009).

McDonald (2007), the exhibit planner and contributor, lamented that from a design perspective, much needs to be done to elevate the parking structure beyond what it has become—"a place of unacknowledged transition and unsettling isolation - to the realm of architectural and planning achievement" (McDonald, 2007, p. 183).

The parking structure has come to represent as much of an annoyance as a convenience: nice to come upon in moments when you need it, not necessarily nice to look at when you do not. At a minimum, the parking structure functions as an engineered system for the efficient stacking and storing of vehicles. These structures are normally built of concrete, or concrete and steel, and are designed within very narrow parameters to maintain their overall efficiency and construction costs.

Parking structures often incorporate an exterior envelope or skin with an adapted motif that separates the engineered structure from the street or public space on which it fronts. This is the “decorated shed” cited in architectural literature (Venturi et. al., 1972, p. 90). Its performance is generally measured in terms of economics, such as cost, occupancy, and monthly rates however, this perspective understates the potential of the parking structure to serve its context and users more meaningfully by:

1. Welcoming users and visitors when situated as the gateway feature in a town or city;
2. Providing a unique and engaging experience that is safe, secure, and easy for pedestrians to navigate, both in and around and the structure;
3. Uniting multiple modes of mobility, including transit, rideshare, and possible autonomous vehicle fleets;
4. Connecting to the street and public realm in a meaningful and active way, with a clear identity and incorporating complementary retail, recreational, or other logical uses; and
5. Contributing to the overall quality and aesthetic of the urban spaces surrounding it, by incorporating appropriate scale, massing, and visual treatments.

It is challenging to fulfill the above objectives, given the redevelopment process’s complexity, level of detail, and the engagement of many stakeholders and decision-makers from the public and private spheres. A parking structure’s final form reflects the

objectives, concerns, and perspectives of all involved, and cannot reliably produce a holistic integrated piece of architecture, let alone a workable parking program.

Parking and the redevelopment process

Real estate development is the process of improving real property. The New Jersey Redevelopment Authority website describes “redevelopment” as development applying specifically to an area that has already been improved and built upon. At a smaller scale, the Authority defines “infill development” as the development of vacant lots in communities or districts that are undergoing redeveloped or have been improved in part (New Jersey Redevelopment Authority, 2019, p. 1). The models and simulations utilized in this research effort address development at all of these scales.

The redevelopment process includes everything from the initial evaluation and identification of need, through adoption of a redevelopment plan, to the designation of a redeveloper, and the actual design and financing of both the public and private improvements designated within a redevelopment plan. The redevelopment process in New Jersey is analogous to other public economic benefit district designations around the country, including “Tax Increment Financing Districts,” “Special Improvement Districts,” or “Business Improvement Districts” (Mead & Cole, 1998, p. 619-622). The common factor informing this research effort is that, in each instance, the conditions surrounding the designation and the process determine its final result. The evolution of a redevelopment plan, of which parking is a prime component, reflects the circumstances that gave rise to it, and the issues or needs it seeks to address. Each

redevelopment designation is directed at an overall outcome that is economic in nature, but which ultimately targets an improved quality of life for current and future residents.

The implementation of structured parking in urban, suburban, and exurban places is a complex process that encompasses its approval, planning, design, engineering, construction, financing, and operation (see Chart 2.5). In an interview conducted for this dissertation, Joseph Maraziti, the former chairperson of the New Jersey State Planning Commission, and a lawyer that is familiar with the redevelopment designation process, explained that there are key factors in the final form of structured parking. These include the following: the thoroughness and detail of the redevelopment conceptual plan, and with it structured parking; whether or not there is time to conduct visioning sessions that allow for the expression and balancing of the interests of residents, property owners, and developers; the designation of a redeveloper of record; and the negotiation of a redevelopment agreement. Parking is but one of more than 40 line-items that require resolution during the negotiation of that agreement; as such, it may not receive sufficient attention. Depending on whether the redevelopment plan is drafted by municipal officials, developers, or consultants, its scope and quality may vary. As Maraziti explains, “Along with the issue of condemnation, parking should rank among the top five items to be negotiated” (Maraziti, 2019).

All of these factors illustrate the need for, and utility of, standards for developing more effective parking. There is a need to educate, inform, and mentor public board members who are not necessarily familiar with the range of related issues addressed in a redevelopment program. Lawyers, planners, architects, and other professionals play a

role in articulating the possibilities and the vision of any redevelopment plan throughout the process. Before they become elements for public review and negotiation in a public forum, there is a need to examine such factors as parking ratios, shared use, ultimate entitled floor area ratios, and the issues of sizing and scale of the final form.

Capital investment and real estate transactions

Cost is a fundamental component in the analysis of structured parking; as such, it cannot be separated from its quality and utility. Stakeholders make real estate investments with the principal intention of generating a profit. The developer's decision to invest is based on many factors that include cost of acquisition, cost of development, interest carry, monthly operations, and how these factors impact individual project pro forma. The average equity fund who co-invests with the developer typically expects returns over a 5-year cycle from initial capital infusion to cash-out over that period of no less than 100% (i.e., 15% average return per year). Given that the standard 5-year yield for a S&P 500 stock portfolio is currently 48% and has spiked to 75% in the past year alone, competition for these funds is keen (Barrons Online, 2019).

Redevelopment outcomes can be uncertain; however, the associated risks can be mitigated if the overall cost of entry and the window for achieving final returns are both clear and can be determined over a defined timeline. Public policy and individual agency decision-making—including the cost and schedule of entitlements and approvals, tax abatements, and similar incentives, as well as the requirements for, or availability of, publicly provided amenities such as parking—plays a huge role in determining the window for success.

Public policy frameworks and parking programs

Stakeholders and decision-makers who engage in the redevelopment process come from a variety of backgrounds and perspectives. The aim of this dissertation is to create a public policy framework for decision-making that is based on a qualified understanding of the parking structure's key physical properties: sizing, scale, massing, visual representation, and placement. Creating neutral, non-situational, and quantifiable design standards that are based on simple, meaningful criteria would enable all stakeholders involved to compare options, facilitating decisions that are more likely to result in structured parking solutions that better serve their communities and users.

This dissertation employs a multi-method research process to rate the values of these five key properties, and to render them as comprehensible, comparable, and quantifiable as those of traditional criteria, including first- and long-term construction costs, monthly rents, efficiencies, and capacity. The methods include iterative design methods and prototype testing, as well as social science research methods, which are discussed at greater length in this chapter's summary.

These insights translate into the creation of guidelines, standards, and strategies for professionals, public board members, and other stakeholders who engage in the redevelopment and public land-use approval process to use in their decision-making. This framework may create a level playing field for all criteria and may provide structured parking with the full breadth of attention that it deserves as a vital component of the redevelopment plan.

Redevelopment typically occurs within a public policy framework that includes

anti-sprawl legislation and transit-related development policy. Scholars have published investigations in the area of infill development, economic assessments of transit village development programs, parking ratios and standards, and other Smart Growth land-use initiatives, including several studies addressing these topics at Rutgers University's Center for Urban Policy Research and the Voorhees Transit Institute (Burchell et al., 2002; Wells & Renne, 2003; Bruegmann, 2005).This dissertation expands the results of social science and design research through a focus on the issues concerning those physical elements that define a well-planned and appropriately integrated parking structure in an urban, suburban, and exurban context.

In addition, because the larger contextual dynamic surrounding parking development and implementation is not fixed, both the literature review and the research phase of this effort addresses emergent trends that stand to impact demand for parking in the years to come. These include demographic and generational changes that impact vehicle ownership and usage; emerging technologies that are reshaping mobility; and changing settlement patterns in urban, suburban downtown, and exurban clustered communities. All point to both a decreased demand for parking over the long-term, as well as to the potential re-adaptation of structured parking and urban infrastructure to new and alternate uses.

Measures that are strictly situational and case-specific cannot be relied on consistently to measure preferences, nor to improve outcomes. Measures of success that are objective—that is, which are defined in non-situational, neutral, and quantitative terms—can be applied in a uniform, conscious, and deliberate way to

produce desired results. The need for such standards of measurement to improve the performance of structured parking gives rise to the five criteria proposed in this dissertation. Sizing, scale, massing, visual representation, and placement are characteristic of all designed objects, including structured parking. These properties are also fundamental to the effective design and configuration of any structure within its specific context. As parking is a significant and early component of the development program, its form, shape, placement, orientation, and visual representation undoubtedly impact other planned buildings in the redevelopment zone.

Each factor has a particular, and potentially powerful, impact on the shape and evolution of a redevelopment zone:

1. **Sizing:** A parking structure's planned capacity, and resulting size, shapes the form, development density, and ultimate floor area ratio for development sites and neighborhoods.
2. **Scale:** A parking structure's height, proportion, and its relationship to neighboring structures (existing or planned) set the essential character of the parking structure within a planned redevelopment or rehabilitation zone. Also important are its relationship to pedestrians, and its ability to invoke or support a "human scale".
3. **Massing:** The totality of the height, width, length, and module, and the approximate relationship of its component parts, suggest the structure's hierarchical relationship with adjacent buildings, open space, and overall timbre of the development.

4. **Visual representation:** The choice of materials and façade treatment can establish, complement, or detract from both the style and quality of future development.
5. **Placement:** The location and design of structured parking enables other planned, mixed, or multiple uses. Its location with respect to transit and other modes impacts movement and mobility to and from the designated zone, and effects pedestrians' visibility, safety, and movement within it.

This dissertation aims to demonstrate that these five criteria can serve as the basis for measuring performance, and that they have the capacity to engender dialogue, debate, and decision-making throughout the sometimes long, and frequently contentious redevelopment process. The standards derived from these criteria, when applied in conjunction with other important and quantifiable issues, can serve to improve the process of structured parking development as well as the overall quality and tenor (i.e. tone and design direction) of the redevelopment zone.

The larger premise of the dissertation

For infill redevelopment programs to succeed, it is critical to properly size, scale, and design parking with regard for massing and aesthetics, just as it must be placed and integrated in the urban streetscape in a way that addresses street design and safety. Given the complexity of redevelopment efforts, any model intended to improve the decision-making process—and with it the overall performance of structured parking—must provide meaningful, quantitative, and consistent means of comparing different options, including the cost of different alternatives in terms of rents, developer returns,

and other economic outcomes.

Fundamental research questions and areas of inquiry

This dissertation examines parking and its implementation by incorporating a measurable and scalable set of criteria and assessing them in a variety of settings. For the purposes of completing the research, two research questions were developed. Research Question 1 asks: *How can the performance of structured parking be improved by examining the following essential design criteria: size, scale, massing, visual presentation, and placement?* The first part of the literature review addresses this question, drawing on an array of sources that impact the understanding and interpretation of these criteria, especially in the context of the urban, suburban, and exurban places where structured parking plays a central role.

The second area of inquiry is the range of ongoing changes that impact private vehicle usage and stand to reduce demand for parking in the future, including demographic and social trends, generation shifts, and changes in overall mobility and settlement patterns. Thus, the second research question was developed. Research Question 2 asks: *How can these considerations be balanced with the following larger and evolving areas of concern: reduced private vehicle usage and parking demand, demographic and social trends, generational shifts, and changes in overall mobility and settlement patterns*?

The research effort and high-level summary

The sections that follow include descriptions of the remaining chapters of this dissertation and their key contents.

Chapter 2: Literature review

The intricacy and transactional character of redevelopment efforts greatly influences their negotiation among public, private, and institutional players. The literature review of this dissertation is organized around those key stakeholders and decision-makers involved in the implementation of this process, and the disciplines or domains they represent: public policy, zoning, and legislation; urban planning and design, city-building, and architecture; and parking as an industry (i.e., the engineering, construction management, and cost control of parking structures). The conclusions of the literature review revealed that these stakeholders and decision-makers do not necessarily share a common understanding of the elements that determine a successful parking outcome. Likewise, these stakeholders do not uniformly consider the implications of a parking structure's sizing, scale, massing, aesthetics, and placement—all of which are critical to its planning and successful integration into a development. Standards for structured parking are left out of most—if not all—municipal codes, including models for many form-based codes emerging today (Form Based Code Institute, 2019). The chapter concludes with a discussion of the emerging trends that stand to impact demand for structured parking, including demographic and generational changes in vehicle ownership and usage; transitions in mobility, including the adoption of ridesharing and vehicle-sharing programs and applications, as well as development of

autonomous vehicles; and evolving development models that represent a fundamental change in settlement patterns trending towards a more urbanized and densified living environment.

Chapter 3: Methodology

Any substantial research effort in which the aim is to understand or improve parking structures and their role in the urban environment is necessarily multi-disciplinary. This dissertation is guided by evidence-based design techniques to assess, understand, and rank the impact of the five key properties on the character and quality of both parking structures and the redevelopment plans they engender. The process incorporates both qualitative and quantitative proofs and other relevant evidence, including comparisons of technical and engineering costs to guide implementation of these best practice examples.

In order to assess and understand demand for parking in urban mixed-use and suburban multi-family settings, the dissertation includes both a survey and a review of census-based, per-family vehicle ownership rates, as well as surveys of parking usage at transit-accessible and non-accessible sites. Six generic prototypes or models for structured parking were developed using an iterative design method, and each was advanced with an appropriate dimensional module, scale, and level of detail for its particular application. After being subjected to a comparative scoring system, each model was then applied to three different New Jersey-based redevelopment case studies that were selected specifically for their broader applicability: (a) Newark Broad Street, a central city transit location; (b) Iselin/Metropark, a suburban regional transit

location; and (c) a 48-acre office park in Morris County, NJ.

A Visual Preference Survey™ (Nelessen, 1993) is used to evaluate each case with key stakeholders and end-users. Further evaluative responses were gathered from individual interviews with professionals. This supports the creation of standards for the successful adaptation and implementation of each model. To provide insight into the actual costs of these various approaches, a pro forma financial model is developed in the research portion of the dissertation. This model incorporates the ability to control for land costs, development area, the cost of parking in various forms (i.e. surface, decked, and garaged), as well as building and site work expenses.

Participants in the focus groups were also asked to select from several upgrades and enhancements to the parking prototypes reviewed. This provides a basis for determining the actual economic impacts of addressing these preferences in a given structured parking program. This serves as a unique and important contribution of the current research effort.

The focus group participants were organized into four groups of ten members each. They consisted of Lay users of parking; Senior architects involved in redevelopment planning projects; Millennial architects with more general experience; and Public officials, including members of local and county planning boards comprising appointed lay and professional members, and other elected officials. Each group reviewed the identical protocols (See Appendix J for detailed exhibits) and were asked to respond to a series of video model simulations as well as more than over 25 direct questions that dealt with issues relate to the future state of automobile ownership and

use, which included the following: transitions in mobility, attitudes about commuting choices, settlement preferences, and the overall future state of mobility and parking, including other demographic transitions in the process. Chapter 4 provides an overview of principal discussions related to these questions. Appendix F provides a complete matrix of responses and Appendix I, offers transcripts of individual sessions.

Chapter 4: Findings

Key findings related to Research Question 1.

The focus group discussions and interviews with subject matter experts confirm that the absence of definitive criteria and neutral standards for performance makes it difficult for public officials, professionals, and the public at large to assess structured parking and determine appropriate paths or directions for improvement. All of the panel and professional participants understood the function and role of the five key areas of interest and supported the creation of standards based on these neutral and understandable evaluators.

In terms of panel member responses in the VPS™, the five criteria are ranked consistently in terms of their importance: (a) placement, (b) visual representation, (c) sizing, (d) scale, and (e) massing. A slight variance by gender is observed across all groups in response to the simulations presented, in that women tended to rank the simulations higher in all cases, but only to a minor degree. No generational biases was observed.

The VPS™ responses result in three preferred prototypes (see Appendices C1-C5 for visual renderings of each model):

1. The freestanding Transit hub parking structure with integrated retail uses and recreation deck;
2. The low-rise wraparound residential mixed-use structure with integrated retail and recreation deck; and
3. The underground garage, with the caveat that the preference for this option is driven down by potential cost, particularly for an automated system.

A scatter plot appearing at the end of this Introduction (see Chart 1.1) shows the relationship of rents to survey rankings. This chart also shows the relative costs of each option against its corresponding rating in the VPS™. The results of corresponding cost analyses on both a first cost and rental basis demonstrates that each of these preferred choices occur at the top of the cost scale. Regarding overall development costs, however, properly sized and configured parking can be a minor component of the overall development budget. The relative costs of development project budgets are indicated in detailed charts provided in Chapter 4 of this dissertation (see also Charts 1.1, 1.2, 1.3A and B, and 1.4A and B).

There are several other key findings regarding the participants' preferred prototypes. First, the transit hub is the highest-ranked solution for structured parking among all respondents. This result aligns with the larger public policy goal of integrating parking with transit in the form of heavy rail. A Senior interviewee stated, however, that obtaining approvals for such structures in non-urban settings is a challenge, as it is with other adjacent and higher-density uses. In New Jersey and similar states, where home

rule predominates and land-planning decisions are locally based and not by county, such challenges are even more severe.

The low-rise mixed-use housing alternate is both the second choice overall and the favorite of the simulated three residential mixed-use models (low-rise, mid-rise and high-rise). The participants prefer all low-rise residential models over high-rise models. This model was presented in rendered form for both infill urban redevelopment and exurban new development programs, demonstrating the flexibility of these models to be iterated in several forms for application to multiple contexts and settings.

The underground garage option, which ranked third, is also associated with several challenges. As panel members' responses show, the public is aware of its relatively high cost. This applies to self-parking, as well as to underground automated parking. The creation of new approaches to underground parking is seen by all participants as a positive goal for future implementation. To that end, an alternative model was proposed in Chapter 4, representing one way of substantially reducing the cost of implementation.

Key findings related to Research Question 2.

Future state of parking and outcomes of reduced parking demand.

(See Appendix F for full matrix of all panel responses.)

Several panel members acknowledged that rideshare and transit play a role in reducing demand for parking. They also state, however, that the likely impact of advances in mobility—from driver-controlled, to driver assist, and ultimately autonomous vehicles—is overstated, at least in the short term.

The panelists do not perceive demographic and generational reduction in car ownership as a foregone conclusion. This will become clearer as more millennials enter their child-rearing years. The millennials who participated in this research effort were not certain how these trends will play out, even in regard to themselves. For those who live in urban places driving is required for a host of reasons, most commonly making shopping, recreation, and day-to-day urban living more convenient. The participants perceive being fully dependent on transit for their daily needs as simply too time-consuming and inconvenient in their busy, family-forming lives.

Regarding changes in settlement patterns, the notion of transitioning to urban living or to living in a more densified environment is not generally accepted by panel members. The respondents also remain unconvinced that living in a more urbanized area necessarily indicates a central or peripheral city location. Living downtown in a suburban setting, or in a townhouse development in a rural or suburban setting, was also viewed as a potential alternative—particularly for those downsizing. This finding suggests that while housing may densify, lifestyles in such an environment may not be any less car-dependent than they are now, because services and recreation outlets are not necessarily accessible by transit or walking in such communities.

Ratios of vehicle ownership per household in both suburban and urban counties was surveyed as part of this dissertation effort and was verified by census data. While reductions in ownership in urban areas is established, similar reductions in suburban and rural areas are not in evidence. This is consistent with the panel members'

responses to housing choices and represents a persistent dependency on vehicle ownership.

Other data indicates a reduced need for parking, despite the panel and survey responses noted above. The Mortgage Bankers Association's report (Mortgage Bankers Association, 2018), as cited and examined in Chapter 2, points towards a future trend of reducing required parking ratios in urbanized areas. The Mortgage Bankers Association report makes clear that the nation is over-parked, and this upholds Donald Shoup's projections in this area (Shoup, 2005).

The question remains, however: of the likely outcomes of a reduced parking requirement, would density increase as an outgrowth of these lower ratios, or simply would less parking infrastructure be built for the same relative density? Would developers bank this savings, or use it as a device for extending yields? The answers to these questions lie outside the purview of this dissertation, yet the framework for that discussion lies within this investigation.

When and if this downsizing of demand occurs, there is broad acceptance of envisioning new uses for parking in all its forms. Those forms include surface lots, parking structures, and structured parking in mixed-use buildings repositioned as new uses. The options panel members propose are somewhat obvious, including affordable and workforce housing, recreation and other public uses, storage, and an array of industrial uses, including small business start-ups or incubator spaces. Likewise, a majority of respondents endorse the siting and design of new structures to meet the requirements for these anticipated uses.

Financial parameters of parking in development and redevelopment settings.

In this dissertation, parking is demonstrated to represent a relatively small percentage of the overall redevelopment budget, especially after incorporating downsized parking ratios. Even when structured parking is upgraded with additional amenity features, such as mixed use functionality, upgraded façade treatments, and active recreation decks, the percentage of developing structured parking costs to the total development cost ranges between 3.6% and 8.2%, depending on the building typology and the parking ratio incorporated in the prototype (see Charts 1.3A/B and 1.4A/B).

The impact of parking on the developers' returns is also addressed in this dissertation. Land, and the cost of site assemblage, is also a factor in development. The implementation of structured parking is often seen as the solution to undersized development sites in urban areas. To that end, the results of the analysis conducted on the issue of parking in relationship to land values in urban areas provides an interesting result.

Developers often insist that the cost of site acquisition along with the cost of infrastructure—including parking—is responsible for the demand for higher and higher densities. Analytical results reveal that even when lands costs are high (e.g., $125-150/FAR foot and $137,500 to $165,000/unit), the project developer is still able to achieve a substantial financial yield—even when a full range of amenities and upgrades are part of the project's parking component (see Chart 1.2). This finding is important because it has the ability to influence the perceptions of public board members, and

the public at large, who might otherwise perceive that mid-to-high-range densities in these settings are a foregone conclusion.

The relationship of transit and parking, and its impact on area real estate values over time has also been proven. The economic benefits of transit-related development in moderate-to-dense places and towns includes the growth of real estate and land values for both public and private landowners. In both instances, the cost of providing parking contributes to this value escalation post-development. The fact that parking helps solidify these in-place values post-development is recognized by a host of parties. A senior official from a local transit agency interviewed for this dissertation states that his agency's position was that they no longer sought to sell assets in these settings but would rather preferred to "stay in" through a series of long-term land leases, so they can participate in the future escalation of land values. This confirms the confluence of transit and parking infrastructure investment as a contributor in value escalation.

Chapter 5: Conclusion, Implications and Areas of future research

The guidelines and standards developed in this dissertation are in alignment with urban design standards and measures found in the literature. They also reflect surveyed user preferences, and a cross-section of comments from laypeople, professionals, public officials, and other experts. When used in conjunction with the technical constraints of structured parking and assessed in conjunction with the pro forma model described above, these standards provide guidance for the implementation of positively perceived structured parking, both in infill and new town development scenarios.

In this dissertation, the model and case prototypes are tailored to a number of

settings and illustrate a variety of approaches to structured parking. Those prototypes, presented in graphic and video form, also feature adaptations for accommodating rideshare and autonomous vehicle fleets in a range of densities, building scales, and yields.

Key implications

Applicability of multi-disciplinary research methods

The integration of iterative design processes, prototyping, Visual Preference Surveys™ in panel form, as well as the integration of survey and economic pro forma analysis are unique to this research effort. These methods provide both a qualitative and quantitative basis for analysis. The narratives derived from expert interviews add color and detail to the overall rankings and assessments conducted. These techniques parallel Evidence-based Design (EBD) techniques reviewed in the methods chapter to this dissertation. The mixed methods approach of this study are applicability to other elements of urban infrastructure and the built environment.

Researchers have commonly applied EBD in such areas as health and education facilities, but it can be further applied to special needs environments, recreation facilities, and other public buildings of related scope. Other applicable and future subject areas for potential investigation include social and workforce housing, open public spaces, and other elements of administrative infrastructure, including public works, police departments, fire departments, and public safety facilities.

The five criteria and Visual Preference Survey™ techniques

Advances in the use of VPS™ techniques in anonymous and remote survey methods, as well as eye-tracking technology, represent new approaches to the administering of VPS™ assessments. The use of five abstract criteria as conducted in this dissertation as the principal evaluators of panel simulations is a new step in the protocols of VPS™ methods.

That these criteria as defined are not only understood but are also embraced by panel members from a range of backgrounds demonstrates that relative abstract criteria can be used as the basis for future examinations. The results of the statistical analysis on both pooled and individual criteria demonstrates that the variance between responses all fall within acceptable confidence levels, and so are valid and accepted responses for these small sample evaluations.

Areas of future research

As the trends addressed in Research Question 2 unfold, it will be important to repeat some of these sessions. However, the benchmarks established in this dissertation will help to measure to what extent vehicle ownership, usage, and parking changes, as many in the profession and the literature expect. It is possible that as these trends gain momentum and their impacts become clearer, the appropriateness and specific advantages of the three highest-ranked best practice prototypes or models will become more apparent. Conversely, as the specific requirements of this building type change in response to ongoing change, the models as conceived may require adaptation or modification.

Similarly, the three lower-ranked models (i.e., freestanding parking deck, high-rise mid-stack and mixed-use prototype, and the mid-rise podium structure) may ultimately require reform or re-adaptation. If so, the same iterative prototyping simulations, focus group panel testing, and pro forma techniques utilized here can be applied to reinventing and readapting those models to a new form and utility.

The conclusions of this dissertation represent insights into the dynamics of the redevelopment process that ultimately impact structured parking's final form. The findings suggest that addressing the redevelopment process itself could be a potential topic of future research.

Summary

The study of structured parking in redevelopment efforts is not a simple or one-sided investigation. As one of the most common first-built structures in a redevelopment zone, a parking structure makes a definitive impact on the ultimate shape, tone, and direction of the redevelopment. Over the course of its initial approval all the way through its daily operation, the implementation process engages all stakeholders and decision-makers from across a range of disciplines. These stakeholders bring their own priorities and perspectives, to the definition of a successful parking structure.

Ongoing adaptations in transportation infrastructure present opportunities for cities to do more than transition to a new mode of transit and use. These opportunities include the possibility of recapturing fallow zones currently sacrificed to fulfilling

overstated parking demand through artificially high mandated parking ratios, and of repurposing them for human use.

These outcomes represent a larger aim for this dissertation effort. By developing concrete models, prototype examples, and case studies of a variety of scales, and testing these forms in a variety of urban, suburban, and exurban contexts, the findings of this dissertation provide a foundation for new standards and ground rules and strategies, which will facilitate the implementation of parking structures that are relevant and useful to their specific communities, settings, and users.

Chart 1.1 depicts the relationship of VPS™ ratings to the costs of parking on a monthly basis. This data is a unique outcome of this dissertation research, and it is described in further detail in Chapter 4.

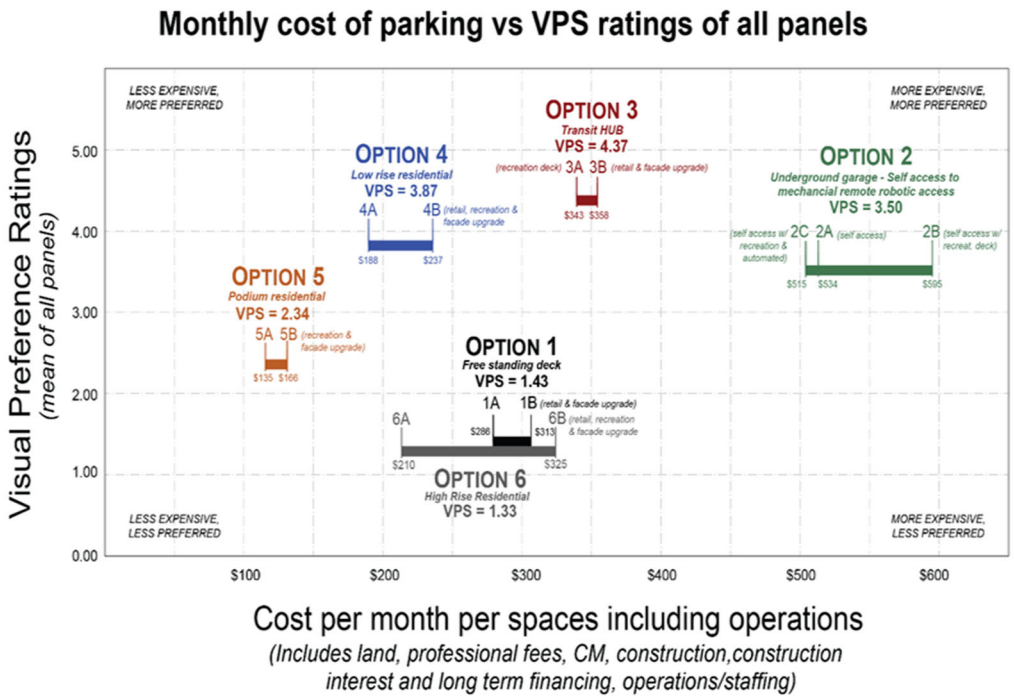


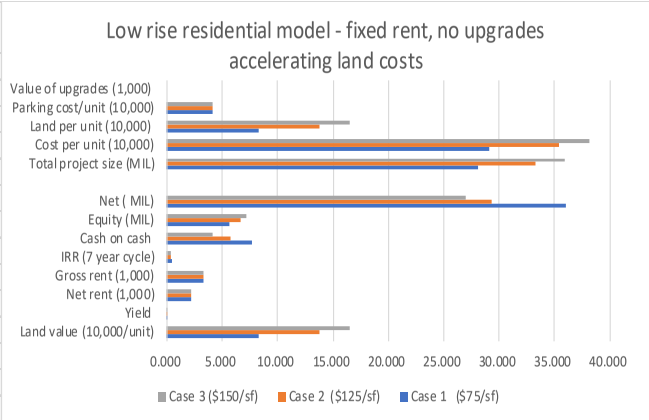
Chart 1.1. Rents vs. VPS™ survey preferences.

A significant area for future research is discussed in Chapter 5, which suggests rerunning the panels with direct and keyed responses to all prototype upgrade options because this effort could provide a method of measuring and assessing user preferences at an even more detailed level. The linear regression for such a model is contained in Chapter 5.

The relationship of parking to developer returns and the cost of land acquisition is depicted in Chart 1.2 and is discussed in the Findings chapter and in the overview provided in this introduction. This information is another unique outcome of the analysis conducted in this dissertation and provides a new level of insight into the relationship of individual components of the redevelopment program including elements such as parking.

The data assembled to complete the analysis provided in Chart 1.2 is a byproduct of a detailed analysis of each prototype, its cost components, and derived monthly rents and developer returns. The financial models developed to ascertain these data points are contained in Appendix A and these overview results are depicted in Charts 1.3A and B and 1.4A and B. The inclusive pie charts illustrate the percentage of rent attributed to parking, including the various upgrades described for both freestanding decks and mixed-use prototypes with structured parking.

Example A Rents for 2 bedrm Parking no upgrades	Case 1 ($75/sf)	Case 2 ($125/sf)	Case 3 ($150/sf)
Land value (10,000/unit)	8.250	13.750	16.500
Yield	9.0%	7.6%	7.1%
Net rent (1,000)	$2.243	$2.243	$2.242
Gross rent (1,000)	$3.343	$3.343	$3.342
IRR (7 year cycle)	44.8%	37.6%	33.4%
Cash on cash	767.7%	574.4%	415.0%
Equity (MIL)	$5.6	$6.7	$7.2
Net (MIL)	$36.0	$29.3	$27.0
Total project size (MIL)	$28.12	$33.29	$35.87
Cost per unit (10,000)	$29.1	$35.4	$38.2
Land per unit (10,000)	$8.3	$13.8	$16.5
Parking cost/unit (10,000)	$4.1	$4.1	$4.1
Value of upgrades (1,000)	$0.0	$0.0	$0.0



Example B Rents for 2 bed rm Parking with upgrades	Case 1 ($75/sf)	Case 2 ($125/SF)	Case 3 ($150/sf)
Land value (10,000/unit)	8.250	13.750	16.500
Yield	9.0%	7.9%	7.4%
Net rent (1,000)	$2.963	$2.963	$2.962
Gross rent (1,000)	$4.063	$4.063	$4.063
IRR (7 year cycle)	41.2%	36.3%	34.1%
Cash on cash	767.7%	568.8%	486.0%
Equity (MIL)	$7.4	$8.5	$9.0
Net (MIL)	$47.6	$40.9	$37.5
Total project size (MIL)	$37.1	$42.3	$44.9
Cost per unit (10.000)	$39.5	$45.0	$47.8
Land per unit (10,000)	$8.3	$13.8	$16.5
Parking cost/unit (10,000)	$4.1	$4.1	$4.1
Value of upgrades (10,000)	$5.5	$5.5	$5.5

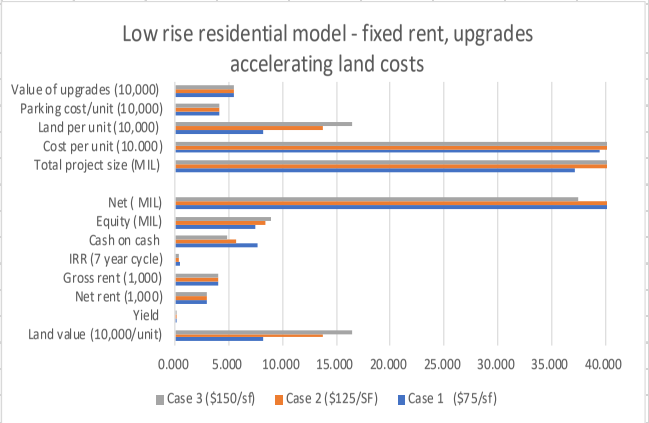


Chart 1.2. Developer returns related to land values and the cost of parking.

Cost components as a percentage of total development costs									Parking decks
	Soft	Interest	Land	Site devel.	Const.	Retail	Recreat	Facade	Automat
Freestanding	15.00%	6.60%	5.91%	6.44%	66.05%				
Transit HUB with upgrades	15.00%	6.60%	4.21%	4.58%	47.02%	8.44%	9.17%	4.98%	
Underground garage - self park	15.00%	6.60%	4.73%	10.30%	63.37%				
Underground garage - automated	15.00%	6.60%	2.49%	10.83%	33.32%		6.77%		24.99%

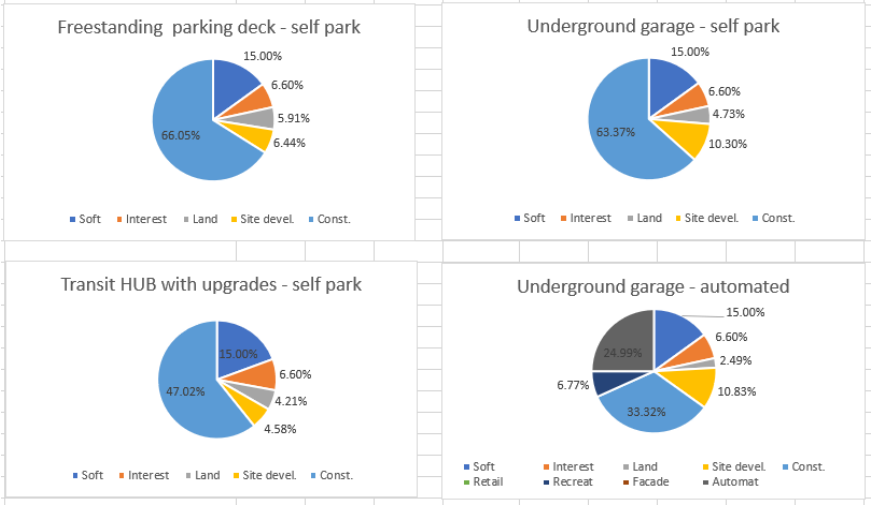


Chart 1.3A. The cost of freestanding parking decks and underground garages as a percentage of overall development costs for both basic and upgraded prototype actual deck construction is between 33% and 66% of total costs.

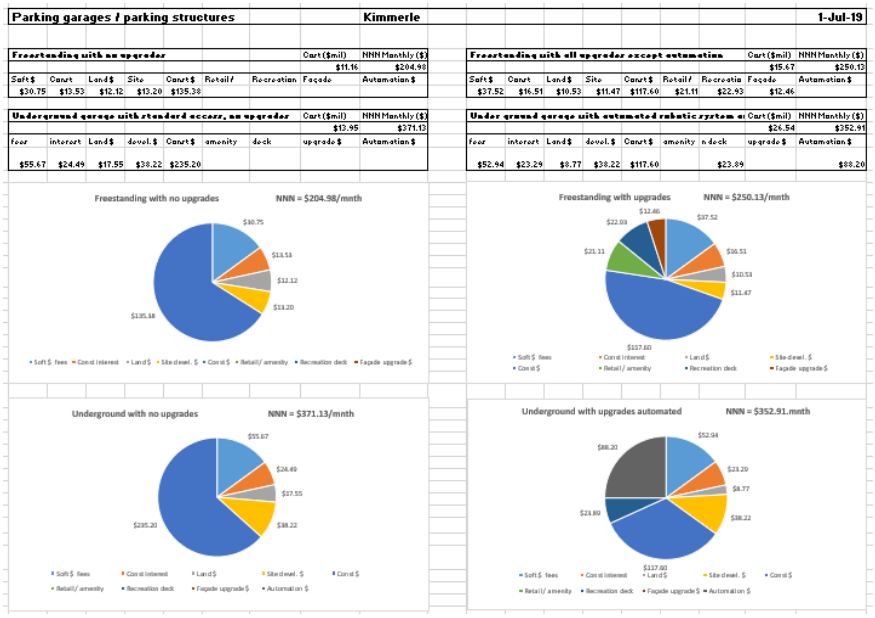


Chart 1.3B. Parking cost components on a $/month/space rental basis.

Cost components as a percentage of total development costs								Mixes use with structured parking	
	Soft	Interest	Land	Site devel	Const.	Parking	Retail	Recreat	Facade
Low rise residential wrap around	15.00%	6.60%	16.37%	3.30%	39.69%	8.19%	3.33%	5.07%	2.45%
Mid rise residential podium	15.00%	6.60%	22.27%	1.58%	45.56%	4.37%	1.77%	0.00%	2.84%
High rise residential mid stack	15.00%	6.60%	24.97%	1.21%	37.84%	4.24%	2.72%	3.38%	4.04%

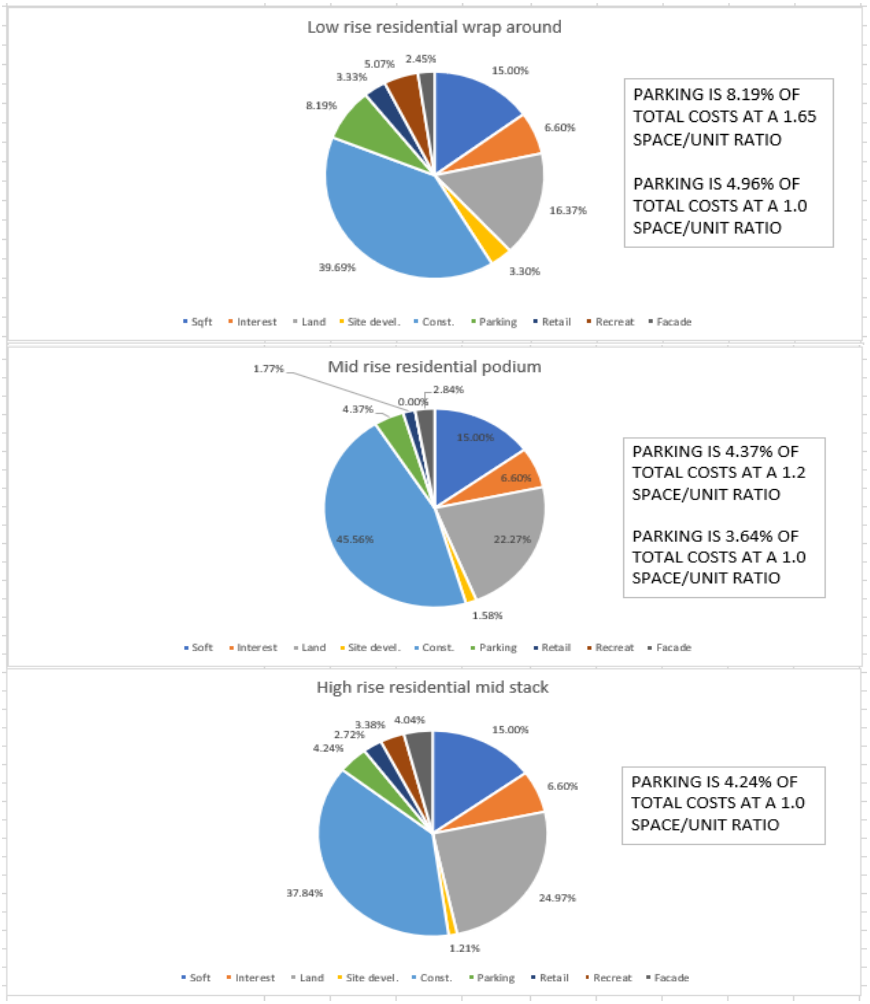


Chart 1.4A. Cost of mixed-use buildings with integrated structured parking components, including percentage of overall development costs for both basic and upgraded prototypes; cost of parking is between 4.20% and 8.20% of total costs.

Mixed use with structured parking — 1-Jul-19

Low rise wrap around - no upgrades							Cost ($mil)	NNN Monthly ($)
							#REF!	$0.00
Soft $ fees	Const interest	Land $	Site devel. $	Unit Const $	Parking Const $	Retail / amenity	Recreation deck	Façade upgrade $
$0.00	$0.00	$0.00	$0.00	$0.00	$0.00			

Low rise wrap around - with upgrades							Cost ($mil)	NNN Monthly ($)
							#REF!	$0.00
Soft $ fees	Const interest	Land $	Site devel. $	Unit Const $	Parking Const $	Retail / amenity	Recreation deck	Façade upgrade $
$444.40	$195.54	$485.10	$97.74	$1,176.00	$242.55	$98.52	$150.13	$72.69

Mid rise Podium - no upgrades							Cost ($mil)	NNN Monthly ($)
							$0.00	$0.00
Soft $ fees	Const interest	Land $	Site devel. $	Unit Const $	Parking Const $	Retail / amenity	Recreation deck	Façade upgrade $
$409.96	$180.38	$646.80	$45.94	$1,323.00	$127.01			

Mid rise Podium - with upgrades							Cost ($mil)	NNN Monthly ($)
							$0.00	$0.00
Soft $ fees	Const interest	Land $	Site devel. $	Unit Const $	Parking Const $	Retail / amenity	Recreation deck	Façade upgrade $
$435.56	$191.65	$646.80	$45.94	$1,323.00	$127.01	$51.45	$0.00	$82.36

High rise mid stack - no upgrades							Cost ($mil)	NNN Monthly ($)
							$0.00	$0.00
Soft $ fees	Const interest	Land $	Site devel. $	Unit Const $	Parking Const $	Retail / amenity	Recreation deck	Façade upgrade $
$507.35	$223.23	$970.20	$46.91	$1,470.00	$164.64			

High rise mid stack - with upgrades							Cost ($mil)	NNN Monthly ($)
							$0.00	$0.00
Soft $ fees	Const interest	Land $	Site devel. $	Unit Const $	Parking Const $	Retail / amenity	Recreation deck	Façade upgrade $
$582.73	$256.40	$970.20	$46.91	$1,470.00	$164.64	$105.56	$131.36	$157.06

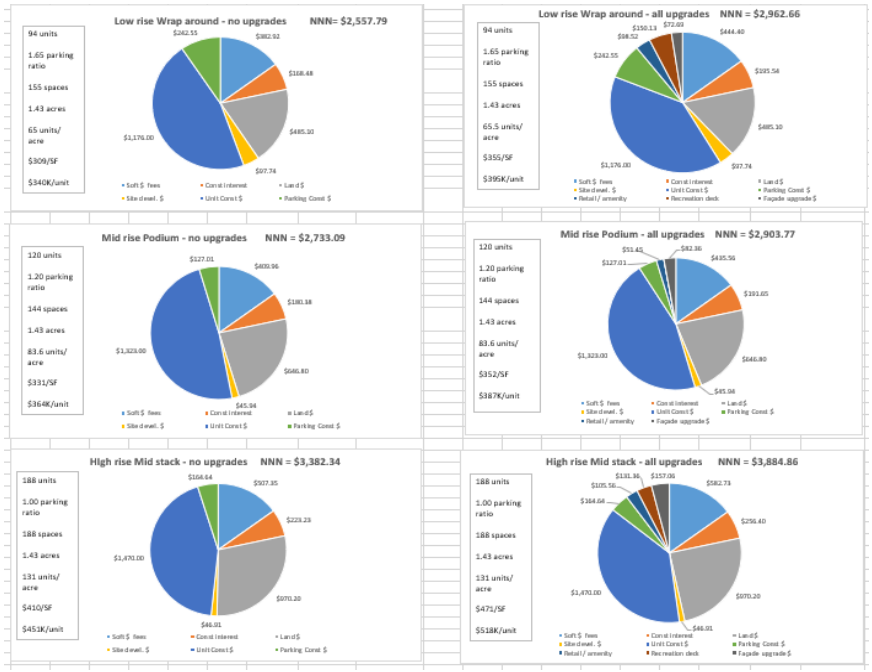


Chart 1.4B. Parking cost components on a $/month/space rental basis

Note: full size depictions of these charts are contained in Appendix H.

CHAPTER 2. LITERATURE REVIEW

Overview

The implementation of structured parking in urban, suburban, and exurban places is a complex process that encompasses its approval, planning, design, engineering, construction, financing, and operation. This dissertation posits that the overall performance of structured parking can be improved by examining its basic nature from the perspective of five normative architectural and urban design criteria: sizing, scale, massing, visual treatment, and placement.

These criteria come into play over the course of an extended process that engages stakeholders and entities from public, private, and institutional domains. Each has its own understanding of the role and standing of parking. As individuals, they bring varying degrees of professional experience and subject matter expertise to the decision-making process. A parking structure's final form reflects all of these perspectives, objectives, and concerns, which may or may not result in the creation of a holistic, integrated parking program.

To understand how these elements come together—the five key properties, the redevelopment process, and the key stakeholders and decision makers who participate in it—this literature review begins by examining parking and its implementation, including:

1. The derivation and definition of the five key properties of structured parking, and their relevance in the literature of urban planning and design theory;

2. The impact of public policy, state and local regulation, zoning and Smart Growth on structured parking's development;
3. The redevelopment process;
4. Parking as industry, and the economics of parking;

The second part of the literature review examines the various social, demographic, and technological trends that impact vehicle ownership and usage, as these stand to have significant impact on future demand for parking.

Part I: Parking and its implementation in multiple settings

The five key properties

The five key properties utilized in this dissertation are based on seven essential parameters of design**.** The consolidation of these parameters from the literature sources used in this dissertation allows for the creation of a set of concise, definable and measurable standards that can be utilized to assess and rank the performance of these structures.

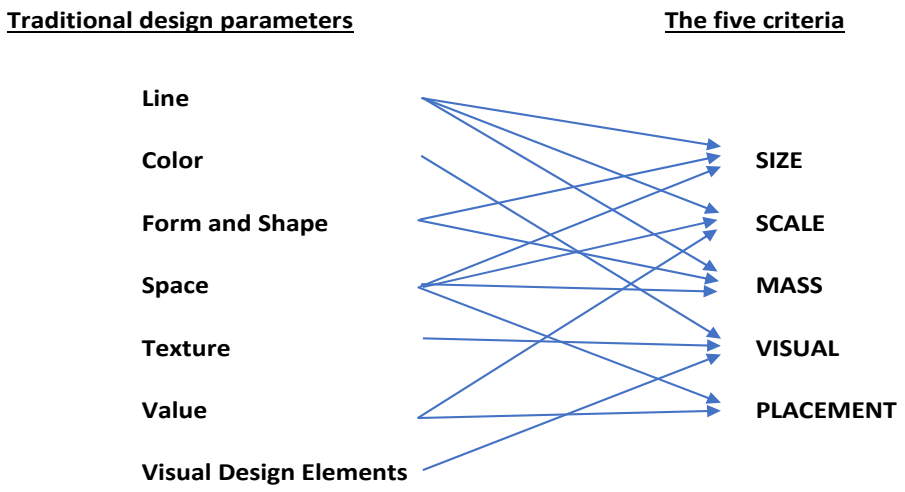


Chart 2.1. Determination of criteria for this dissertation and research effort.

Note. Sources include Akin and Moustapha (2004), Anderson (1978), Giedion (1982), Jacobs (1995), Kostof (1993), Lynch (1960, 1981), Moore and Allen (1976), Perren and Mlecek (2015), Washburn (2013), and Winters (2007).

These specific five criteria were derived from the literature and finalized in consultation with the dissertation committee. A broad discussion of buildings, architecture, and city form is found in *Perception and Architecture - Here and Now* Perren and Mlecek (2015). Specific references include Giedion's (1982) larger historic perspective in *Space Time and Architecture*, Moore and Allen's (1976) examination of size and scale in *Dimensions: Space, Shape, and Scale in Architecture*, and Lynch's (1981) work in the visual and mental mapping of the city. These disciplines driving the discussion of these five key properties also include architectural cognition studies, gestalt psychology theories (i.e., human perception of physical space and visual forms), and the larger discourse of architecture and urban theory.

In *A Theory of Good City Form*, Lynch (1981) provided five related criteria or areas of interest, defined in relationship to the larger city space.

Criteria	Summation from Lynch's text
1. Vitality	Sustainability. Safety. Viability of urban systems.
2. Sense	Visual. Spatial. Scale and a sense of place.
3. Fit	Size. Utility. Scale to an intended functionality.
4. Access	Placement. Entry. Network. Mobility and class issues and access to basic services and amenities including parks and open space.
5. Control	Districts. Borders. Limits. Public zones. Private zones. Ownership and appropriation issues.

Two "meta factors" provide the means to balance and check the above criteria:

1. Efficiency	The issue of use and balanced outcomes - a cost benefit approach to the section of implementations
2. Justice	The overriding issues of distribution and fairness.

Chart 2.2. Criteria in relation to Lynch's (1981) text.

Sizing.

Sizing addresses a parking structure's physical measure, as well as its capacity. Demand is determined from a series of parking ratios related to adjoining uses. The examination of these ratios in the urban context has been in progress for some time. In this dissertation these examinations are supplemented by multiple surveys of ownership and usage conducted for this research effort. These include: an identified mixed-use building in Hoboken, New Jersey, located directly on a mass transit connector to regional rail systems; other transit-located parking surveys; census examinations; investigations into state agency standards such as New Jersey's Residential Site Improvements Standards (RSIS); and a user survey conducted in the context of a Visual Preference Survey™ (VPS™), which addresses a variety of transit and non-transit accessible sites (See Appendices G-1 through G-6 for details related to these survey results).

Parking demand, and structure sizing, are also related to generational norms in terms of car ownership, ridesharing programs, and access to alternate forms of transportation, including walking and biking. These issues are touched on in the Literature review and discussed in the Areas for Future Research in Chapter 5, of this dissertation. A community's ability to achieve near 100% utilization of its existing parking inventory helps to determine the need for – and subsequent size of – new parking construction. New management techniques, such as smartphone applications, are serving to maximize parking inventory by communicating availability on a community-wide basis.

Scale.

Scale describes the relative relationship of parts of a parking structure in relationship to its surroundings and in terms of its overall balance and proportion. The term "scale" can have multiple uses. For the purposes of this dissertation, scale refers to the overall height and width of the structure, and its relationship to other buildings and structures along a street, and its "contextual" neighbors.

"Proportion is the term used to describe the relationship between two things of different size...We often talk about this kind of proportion as 'scale' when we speak about a building" (Architecture and Aesthetics, 2002, p. 7). A classic example of proportion is the relationship of the building's height to the width of the street.

"Scale," in terms of public spaces and street space, can also refer to a relationship of building features to the human experience. "Human scale" describes the level of comfort and accommodation to human use and well-being. Project for Public Spaces provides the following definition in relationship to its guidelines for place-making. According to Burke: "In its simplest definition, creating a human scale environment means making sure that the objects that we interact with every day are of a size and shape that are reasonable for an average person to use" (Burke, 2016, p. 1).

Massing.

Massing concerns the external architectural form of a parking structure: its bulk in height, width, and depth. "Architectural massing is the act of composing and manipulating three-dimensional forms into a unified, coherent architectural configuration...this includes the relationship [of the building] to its surrounding context

and of the building with its sub-parts... as [in its] impact on the urban environment" (Akin & Moustapha, 2004, p. 31).

In day-to-day practice, massing is the process of programing the required overall square footage of a building against a series of floor area ratios (FARs), as well as height and setback requirements contained in local zoning law. Local zoning texts attempt to define or control building massing. For example, the New Urbanist model codes being used in many cities include a mix of criteria (e.g., permitted maximum building heights, local area and streetscape character) along with recommendations for breaking down or organizing the mass of a building (Borys, Talen & Lambert, 2019; Madden & Russell, 2014).

In establishing zoning standards or guidelines, a common device for controlling massing is to develop a consistent street-wall and base-height between four and eight stories, a series of setbacks above that base-height related to a "sky plane," with unlimited tower-heights above this point. In that way, a human scale is maintained and the shape and dimension of the street space itself is controlled. Sky plane is defined here as a zoning device or regulation that limits the base-height of a structure to a proscribed maximum story height, but also allows the building to exceed that base-height to the extent that it rises above that height by a prescribed angle or setback ratio).

Massing is one area of practice where zoning standards cannot be applied directly and uniformly but must rely on the individual designer's skill and insight to derive an appropriate and effective building form for its context. When performed

badly, potentially deleterious consequences are found in the height and relationship of parking to neighboring structures (existing or planned). If improperly scaled and massed, parking structures can overwhelm streetscapes in neighborhoods and in downtown settings. They can create unsafe zones in otherwise safe and secure settings by creating blind spots and otherwise ignoring guidelines for observable and policeable spaces. At their worst, they become real barriers to integrated neighborhoods and walkable street patterns.

A structure's module, or the approximate relationship of its parts, as well as its features suggest parameters for adjacent buildings, open space, and overall tone of the zone. As many times the first structure erected in a redevelopment setting, parking structures and how they are implemented can establish the essential character of the planned redevelopment zone.

Visual.

The visual aspect includes the presentation or treatment of a parking structure, or the aesthetics of parking. Architectural aesthetics is a broader area of inquiry. It is an evolving chain of discourse linked to the epistemological and academic schools of thought of the past century and more. Here, its use is confined to the elements of architectural or façade treatment. The following definitions represent the points of aesthetic inquiry and examination for the cases proposed in this research:

1. Rationalist or modernist: linked to high-tech expressions;
2. Traditional or classical: reductive historic facsimiles, including postmodern applications;

3. Brutalist or structuralist: generally expressive of the building's constructed or sculptural form; tectonic approaches to constructability are included here;
4. Sustainable iterations including green designs; and
5. Original, or of an individual expressiveness, including deconstructive forms.

Placement.

Placement refers to a parking structure's site within the city space and streetscape. This addresses where the structure is sited within the context of a city—that is, whether it is placed at a significant node or point of connection, such as a major intersection. The location of transit centers with accompanying parking plays an important role in organizing and channeling the movement of people. The location of these structures can have an enormous impact on congestion, pedestrian confidence, and street interaction. From the perspective of sheer capacity, there are also locations in the street network which have a greater capacity to absorb larger numbers of parked cars and therefore are larger. For example, areas of high density at major street intersections or corner location as opposed to mid-block sites, may be able to host bigger and taller structures, which in turn can more easily integrate major parking and transit structures—if only because access to east-west streets and north-south avenues converge in these locations.

Safety at the street level is essential. Walking distance to various uses is the most critical element in the location, placement, and scale of a mixed-use parking structure. When a semi-public, public, or private parking structure is located in an urban context, it must logically accommodate and integrate the movement of transit, private vehicles,

and pedestrians (and potentially in the future, of driverless and semi-autonomous vehicles). The integration of horizontal and vertical movement—of vehicles and pedestrians—must be addressed in planning.

In areas of lower density, including residential neighborhoods, siting these structures in lower-scaled contexts requires a balanced and measured integration of building modules, forms, massing, placement and aesthetics.

The five properties in the literature of urban planning and design theory

Kevin Lynch and Jonathan Barnett (Lynch, 1960; Barnett, 2003), both key sources for this dissertation, recognized the city space overall as a linked and integrated "whole." This whole is not possible in the absence of the correct and mindful placement of structured parking. Jane Jacobs' (Jacobs, 1956) focus on the larger city network also places a premium on the placement of structures. The importance of placement is touched on in Giedion (1982) and Mumford (1960), which emphasize the importance of integrating communities into larger systems of transit.

Just as with Jacobs' focus on neighborhoods and the street space itself (Jacobs, 1956; Lynch, 1960; Barnett, 2003) argue for respecting individual districts: everything from their character, nature, borders, and edges, to their relative scales and densities. This puts issues of sizing and scale front and center.

Under a landscape urbanist and critical regionalist banner, Waldheim (2002) stresses the need for these forms to be located or placed in an integrated way in a larger network. That larger network comprises such concerns as water quality, drainage,

and sustainability as well as larger issues such as global warming, carbon emissions, armament to sea level rise, and similar subject matters.

The placement of entry points for both pedestrians and vehicles, as well as drop-off zones, must be carefully considered and coordinated. In terms of parking structures, this has implications for placement of parking ramps and driveway access points. Placing them outside of public view or internalizing them can support both pedestrian and cyclist safety, as well as helping to control traffic flow, and minimizing congestion on adjacent streets.

Moore and Allen (1976) and Rowe and Koetter (1975) are both concerned with respecting the overall urban context, making the scale of a structure a central element to be considered. This is not to suggest that structured parking or the buildings of which it may be a part must be subservient to neighboring structures. Rather, its overall exterior elements (i.e., its massing) must be integrated within the larger organized or composed whole of patterns, shapes, and forms.

Visual representation derives from a larger discourse in the appropriate treatment of architectural forms in their relative contexts. Robert Venturi, along with Andres Duany, Peter Calthorpe, and Ethan Kent, argues for visual representation that is engaging, with are consistent with and referential to the larger traditions in the urban environment (Venturi, 1965; Katz, 1994; Kent, 2015; Duany et. al. 2010). Further, all of these authors emphasized that visual representation should be thoughtfully considered to accommodate and engage at a “human scale.” This suggests that a structure’s fenestration or façade elements, including individual details of entry and other

openings, and architectural features must perform well at the street scale and in the public space in which it is found or the building fronts.

This contrasts with the perspectives of Simon Henley and Shannon McDonald (Henley, 2007; McDonald, 2007), both of whom considered parking structures to have their own integrity and ascribed role in the city space. Parking structures as an architectural form or independent building typology need not be adorned nor disguised behind false or reductive façades. Modernists such as Santiago Calatrava and Phillip Johnson concur with this side of the aesthetic or visual debate, as well and argue that such buildings have their own internal ethos or design integrity (Calatrava, 2010; Wigley & Johnson, 1988). Although the author of this dissertation endorses this position as an architect, in the context of urban design and planning, ascribing this independence of form and aesthetic for any building topology depends wholly on the site, setting and context. Frampton (1983) and Kelbaugh (2002) argue for a localized vernacular and culturally integrated approach to visual façades and forms which includes local traditions in the sizing, scaling, and massing of these structures. An extended and fully cited discussion of the relationship of architectural and urban planning theory and parking, appears in *Supplement to Literature in area of urban design theory*, appearing in the Literature review chapter (Chapter 2).

Public policy, state and local regulation, zoning, and Smart Growth

Although a range of demographic, resettlement, and technological trends are changing the face of vehicle ownership and use, and consequently demand for parking,

the primacy of the automobile in the built environment has long gone unquestioned until Donald Shoup and others began to address it. As Shoup (2019) points out,

> U.S. cities have unwisely adopted car-friendly policies. Separated land uses, low density, and ample free parking create drivable cities but prevent walkable neighborhoods. Although city planners did not intend to enrich the automobile and oil industries, their plans have shaped our cities to suit our cars. (p. 1)

The consequences are quantifiable: in an overview of national parking by the Mortgage Bankers Association in May 2018, the authors surveyed five typical cities across the US: New York City, Philadelphia, Seattle, Des Moines, and Jackson Hole. The study not only details the number of local parking spaces in each location related to census counts of households by square acre, but includes parking on-street, in flat lots, and built structures (Mortgage Bankers Association, 2018).

A summary synopsis from Mortgage Bankers Association's report includes derived ratios. The relationship of structured parking to overall parking capacity and underlying household density in the five cities featured in the study has been calculated in this dissertation. Charts 2.3 and 2.4 depict these ratios and an extended analysis of these figures appears in Appendix G-1. Additionally, the Mortgage Bankers Association's study relates all of this data to land value by district in each city, an important secondary level of data analysis that depicts households, jobs, transit and parking in its several forms in relationship to these other factors (Mortgage Bankers Association, 2018).

Likewise, the issue of escalating land values in relationship to parking costs as a percentage of rents impacts developer returns (see Introduction and Findings chapters).

This issue of land value in relationship to parking is particularly relevant and helps define the impact parking can have on urban and infill building, a central area of interest in this dissertation and relevant to the future outcomes for parking in all contexts. Two representative charts (Charts 2.3 and 2.4) extracted from data available in the Mortgage Bankers Association's study illustrates the state of parking nationwide. The range between household density to parking spaces per acre as portrayed in the Mortgage Bankers Association's study displays an incredible contrast. New York City has 18.1 households per acre and 10.1 parking spaces per acre (a ratio of 0.56 spaces/household), which stands in contrast to Jackson Hole, WY. with 2.0 households per acre and 53.8 parking spaces per acre (a ratio of 26.9 spaces/household). NYC inventories parking at 1.04% of Jackson Hole's inventory on a per household basis.

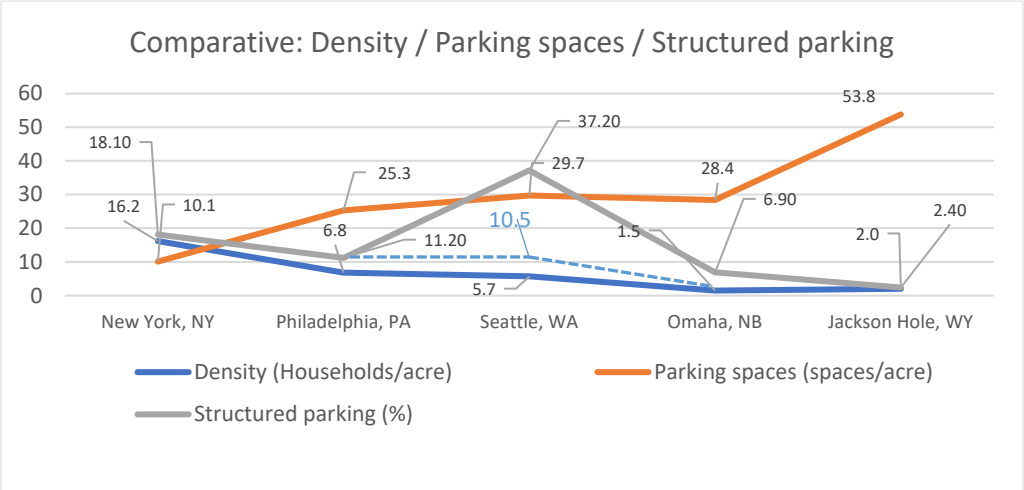


Chart 2.3. Comparative of density, parking and structured parking (Mortgage Bankers Association Parking Report, 2018).

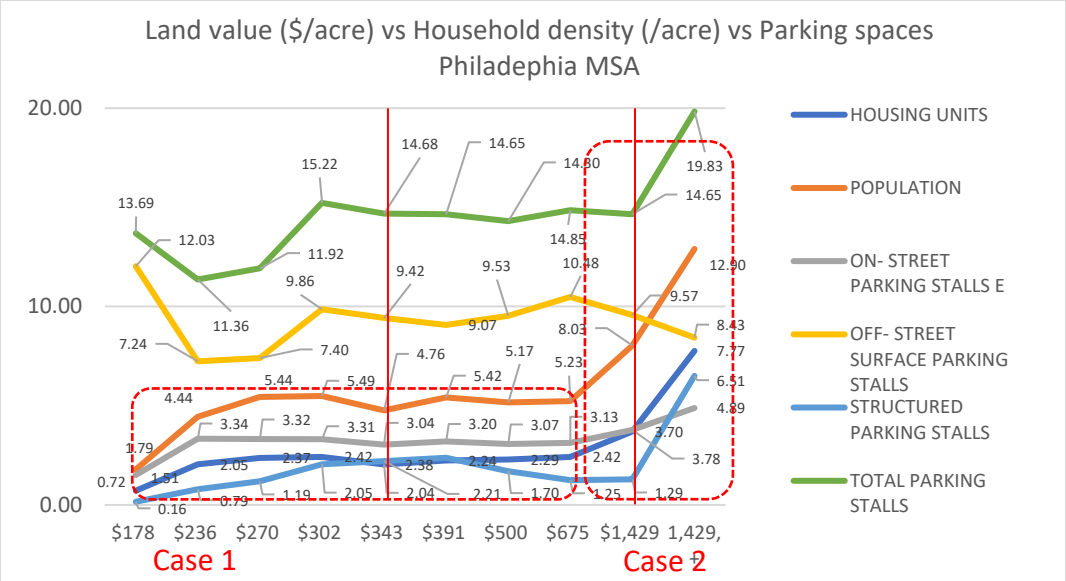


Chart 2.4. Land values and household density vs parking spaces in Philadelphia, PA. (Mortgage Bankers Association Parking Report, 2018).

(note that MBA cites land values on a per square foot basis, while the figures here have been adjusted here to represent land areas on a per acre basis for clarity. This accounts for the uneven units of measure being portrayed)

Several significant conclusions can be drawn from Charts 2.3 and 2.4. First, the figures observed in Chart 2.3 indicate that total parking across the five cities studied equates to a total of 7.45 million spaces with a replacement value of $80.9 billion. Of this total, 18.87% of the spaces are comprised of structured parking.

Extending these totals, the replacement value of structured parking across these five cities equates to a total investment value of $65.4 billion, with 81% of the total replacement value reported by Mortgage Bankers Association (using per-unit estimates of constructed value adjusted for each region).

Scale of structured parking investment across the United States

To set the larger context for this dissertation, the total population of the five cities under examination amounts to 11.4 million people or 3.4% of the total United

States population in 2018. On this basis, assuming for the moment that the five cities examined represent a true cross-section of the country, by extrapolating the total invested in-place value of structured parking across the United States amounts to a staggering $1.94 trillion.

Assuming that these structures maintain an average usable life of 30-40 years, the replacement value alone of the in-place inventory of structured parking across the county amounts to the sum of $55.0 billion annually.

An additional note concerning Chart 2.4 deserves mention. The areas denoted as Case 1 and Case 2 represent the equivalent of parking occurring over the full range of land values, i.e., Case 1 ($170,000 - $675,000/acre) versus Case 2 ($675,000 to over $1.3 million per acre). In the first case, structured parking amounts to approx. 2.0-2.4% of the total parking inventory, while structured parking equates to upwards of 6.5-7.0% of the total parking inventory in the second case.

The amount of structured parking tracks with total population and density. In Case 2, while total population grew approximately 150% on a per acre basis, structured parking has increased at an accelerated rate to 175% of total parking inventory. This is a logical and informative deduction from Mortgage Bankers Association's data.

This is significant because like any demographic, it is the middle region of the distribution, which represents the largest impact, be it in education funding, tax revenue or any other public assessment. Likewise, this middle area of parking distribution considered in this study is where parking is most prevalent, though it is given the least amount of attention.

Clearly, as land values and density increase, the complexity of the development program also increases. Designing structured parking that performs well and is appropriately integrated into its surroundings becomes an expectation, and project budgets and the talent of the design professionals engaged likely assures this outcome. However, in this other zone, Case 1, parking fails to receive adequate attention, and its generic implementation becomes underwhelming and unexceptional. To a large extent, regarding Case 1, this dissertation points a direction, and the Design guidelines and Implementation strategies promulgated by this research effort gain substance and relevance

What is dramatically clear is that based on the Mortgage Bankers Association survey results, the investment made over the past several decades in parking infrastructure is unbalanced—so much so that the country is over-parked. The scale of land area devoted to parking in American cities is staggering and becoming more so given parking's role as the device that unlocks urban density in central city, suburban downtown, and exurban cluster settings.

The Mortgage Bankers Association report also provides a sense of the massive investment in structured parking that has occurred over time and continues to made in American cities, a subject we should also be alarmed about given the larger public agenda that confronts the nation including healthcare and hospitals, education and schools, and affordability issues in the housing market.

Anti-sprawl legislation and Smart Growth initiatives

Anti-sprawl legislation encourages higher-density development in existing communities, particularly where direct transit access exists within a five-minute walk. Structured parking is also necessary in order for such policies to be effective, making the design of parking a key component of housing and infill development; yet increasing housing density in the suburban setting of existing communities is controversial (Kimmerle and Robbins, 2005). Communities resist change and the integration of mixed-use housing in downtown setting even when accompanied by structured parking.

Literature in this area includes Center for Urban Policy Research's *The Costs of Sprawl 2000* (Burchell et al., 2002) and *Urban Sprawl: A Comprehensive Reference* (Soule, 2006). These texts trace the larger public policy dialogue concerning anti-sprawl initiatives, and the efforts over the past 30 years to refocus development towards the urban core by means of housing and transit initiatives and zoning reform. However, the issues associated with sprawl continue and are re-emerging. Recent sources point towards a reemergence of sprawl post the 2007 housing recession. The focus on fringe development is now overtaking infill redevelopment of American cities in the interim years. The cost of development in urban settings is attributed to much of this, which is expressed by Schmitt in a recent article: (Schmitt, 2019).

> "the "return to the city" movement is dead — or so say some news outlets after data from Brookings showed population growth in the suburbs outpacing that of cities, especially among millennials" (p. 1).

Schmitt further reports that the "exurbs grew at about four times the rate of urban core cities in 2016 and 2017, per Brooking's reports — a change from the

previous several years, when core cities dominated" (p. 1). Following the theme of affordability, James Brasuell states that the return to sprawl is being protracted by economic forces" (Brasuell, 2019).

> "Even in the midst of a climate crisis, the Bay Area's skyrocketing housing costs are pushing families into far-flung suburbs like Tracy. And the American dream of a single-family home coupled with cities' restrictions on building multi-family rentals and condos means "exurbs" continue to thrive despite state and local officials' recognition that they exacerbate climate change (p. 1).

Equally troubling is the fact that in the cited example, Tracy, California, located 60 miles from San Francisco, the model returned to single-family detached housing as opposed to clustered or multi-family housing, which was the preferred model for development in exurban regions. Despite these recent trends, the focus remains on densified communities. Whether located in urban, suburban or exurban areas, public policy and good planning objectives nationwide are advanced through densified settlement, as these reports cite.

The Regional Plan Association's report, *A Region at Risk* (Regional Plan Association, 1996), provides earlier context for this problem in the New York metropolitan area. The report targets redevelopment at defunct ports and industrial sites, and at regional transportation nodes and centers. The Regional Plan Association also provides recommendations that respond to parking demand and its potential impact on both urban and suburban development.

The federal Environmental Protection Agency's (EPA) report, *Parking Alternates: Making Way for Urban Infill and Brownfields Redevelopment* (Snyder et al., 1999), was

published at that time and in conjunction with the passage of significant changes in federal legislation influencing brownfields remediation in the 1990s. This report examines the demand for parking as a critical inhibitor to the overall public agenda of Brownfields redevelopment and urban infill. The report also provides revised and reduced parking standards and costs and offers alternative funding scenarios in which municipalities collect Payment in Lieu of Parking fees (PILOP) from developers so that parking infrastructure might be regionalized and managed from a single and coordinated public agency or source.

PILOP programs are a means for communities to increase density without incurring the disruption caused by the creation of individual, dedicated on-site parking. In lieu of creating parking, development projects are assessed a per-unit fee. The funds collected are applied to municipal parking programs and other amenities. Boston, MA; Columbus, OH; Miami, FL; and Hackensack, NJ, have adopted these programs.

Per a 2015 ordinance passed in Hackensack, NJ, current assessments are $2500 per space for affordable units, $5000 for rentals, and $9000 for condominiums. Up to 100% of the on-site parking burden can be transferred on this basis, with the approval of the Planning Board and Board of Adjustment. The ordinance only applies to areas designated in need of redevelopment or rehabilitation (Hackensack NJ Code, 2015).

In Miami's Coconut Grove section, the fee is $5400 per space or $50 monthly per space. Ninety percent of the revenue goes to a long-term parking improvement trust, 10% reserved for future projects such as newly constructed parking decks. The funds are also used for Special Improvement District (SID) promotions and street fairs. The City of

Miami has projected that 300,000 SF of otherwise disruptive surface parking lots have been forgone over the past 10 years through this program (Nichols, 2013, p. 1).

The Center for Urban Policy's *Parking Matters: Designing, Operating and Financing Structured Parking in Smart Growth Communities* (Bier et al., 2006) places specific emphasis on reforms to New Jersey's site development and parking standards. The report arrived in the aftermath of significant legislation known as the New Jersey Highlands Act of 2004, which projected significant shifts in population and development activities back to the urban core.

New federal EPA standards for the recycling of urban and industrial sites for alternate uses, including housing, was one component of the report as were revised and revamped parking standards for urban areas. Parking—in the form of structured parking—is cited as a significant enabler of redevelopment activity in both EPA's 1999 and Bier et al.'s 2006 study.

The standards offer several design criteria relevant to the current inquiry. For example, "parking structures should be no taller than surrounding buildings" (Bier et al., 2006). In those cases where policy standards for downsizing demand turn out to be less than effective, the standards propose using management and financing as a means to control impact on infill. Public bonding, management innovations, inventory control, and other fee- or fine-based methods to limit parking demand are also mentioned, as are shared parking arrangements between non-consecutive uses.

When parking ratios are reduced, or a shared parking program is integrated into the plan, the result can include both increased densities and a more complex array of

mixed uses. Shoup (2018) confirms this, when he states that for transit-located redevelopments, “Reducing the parking requirements in transit-rich neighborhoods can ...[make] higher density more feasible” (Shoup, 2018, p. 102).

Dense urban municipalities have taken the lead here. In 2016, Washington, D.C. reduced its parking requirements for new multi-family developments to 0.33 per unit (Giambrone, 2016, p. 1). Jersey City has a ratio of 0.50 per unit. New York City requires that 0.70 of its new multi-family rental units be assigned a parking space. Meanwhile, New York University’s Furman Center issued a 2012 report related to household parking ratios in the five boroughs of New York, which indicates that in areas of the five boroughs where transit access is available, car ownership can be as low as 0.5 cars per household (Furman Center, 2012, p. 6-7).

Overall, New Jersey has maintained a consistent and much higher ratio in its downtown redevelopment zones of 1.75 spaces per one-bedroom housing unit. That being said, changes are in progress: these higher ratios in New Jersey are falling in light of demographic changes and the increased emphasis on transit access. Urban parking is seeing a reduction and has been codified in the state’s Residential Site Improvements Standards published by the Department of Community Affairs. These permit 0.5 to 1.0 spaces per unit in specified zones in such cities as Hoboken (New Jersey Department of Community Affairs, 1998). New Jersey towns are also allowed to supersede these regulations on an individual basis based on the scale and scope of individual applications.

Donald Shoup's observation that regulating parking by minimum standards instead of maximum standards consistently leads to oversupply and waste was confirmed in a 2017 article in the *Economist* (Shoup, 2017). On the heels of the city of London's elimination of parking requirements in some zones, the article—citing the research from the Furman Center—reported that "parking in new residential blocks plunged from an average of 1.1 space per flat to 0.6" (Berg, 2016, p. 2). A report which investigated parking ratios by household in the Manhattan core indicates that the rate has increased to 0.26 cars/household in 2009 from 0.22 cars/household in 1980. This is in part attributed to an increase in the availability of parking facilities for residents due to an actual decrease in the number of commuter vehicles entering the CBD, and a shift from minimum to maximum standards for new construction. Parking in Manhattan has been cited by this 2011 study at an average monthly cost of $538.00/vehicle versus a national average of $161.50, a 240% differential (New York City Department of City Planning, 2011, p. 14-16).

These "smart growth" policies emphasize high-density development. The new urbanism website, newurbanism.org, states that "high" density suggests housing densities of 30-35 units per acre, at four to five stories (New Urbanism, 2019). Low-density communities and neighborhoods are those with two- and three-story building heights and housing densities averaging between 10-15 units per acre. The structured parking needed to support high densities, and the characteristics of the parking structures themselves are largely ignored in the policies. This dissertation seeks, among other things, to offer a means for addressing this omission.

Zoning is a leading determinant related to how land area is developed. Zoning was first spawned as a series of restrictive district regulations segregating specific uses in the turn-of-the-century American industrial context. Since then the use of uniform zoning standards accompanied by these single-use district designations has been blamed for the monotony and sameness of American suburban development patterns - increasingly so as the impacts of these rules and regulations become evident.

At the state and local level, legislation regarding both parking demand and required parking ratios impacts the size of parking structures. In addition, the ultimate size, massing, and placement of parking structures is impacted by local zoning standards directed at both floor area ratios and height, setback, and bulk standards—all of which are key physical properties directly relevant to this dissertation.

Floor-area ratio regulations are perhaps the most effective regulation for controlling a building's program. Because height and setback requirements vary by municipality, a wide range of alternative building options can exist for any one case. This flexibility presents many options for how to configure a site, along with its proposed use or uses. References on this topic include: *Zoned in the USA: The Origins and Implications of American Land-Use Regulation* (Hirt, 2015) and *Smart Growth and Infill: Challenge, Opportunity, and Best Practices* (Listokin et al., 2007). The latter looks at an array of hurdles to infill development, including per-unit or household parking standards.

A recent article in *Development Magazine*, a National Association of Office and Industrial Parks (NAIOP) publication, addresses parking in mixed-use environments: "Parking is almost always a concern... …the amount of allowable and/or required

parking may be impacted by many factors, including supply and demand, local zoning and proximity to public transportation. How parking is allocated and whether it is assigned or unassigned, self-park or valet, free or fee-based, operated by a private company or an owner's association, are all questions to be addressed" (Dubrasich, Cox, Castle & Nicholson, 2017, p. 1).

Demand is a function of these parking standards, and therefore, the basepoint for determining size (Listokin et al., 2007). In day-to-day exercises, planning boards revert to old and existing institutionalized standards that are hard to break and generally overstated in terms of actual demand.

In the face of current demographic trends, a number of municipalities have concluded that their standards need revision. The report from New York University's Furman Center, *Searching for the Right Spot* (Furman, 2012), provides a detailed survey of parking and ownership in the five boroughs of New York City, with averages as low as 0.5 to 1.0 space per household in the outer boroughs with transit access (p. 8).

Cities like Boston, Seattle and Portland have essentially concluded that they are over-parked, though much of this may be due to the significant investment in parking that has occurred in these locations over the past few decades. The City of Boston, citing recent demographic statistics, has decided to downsize overall parking ratios based on this perceived reduction in demand across the city (Ross, 2013, p. 1).

Contextual zoning standards and accompanying design guidelines are more aggressive, and can be imposed in more traditional, older, or historic districts. In these cases, planners are tightly controlling the ultimate size and scale of new development to

align with an existing setting or "context." Contextual zoning in New York City, for instance, is often the outgrowth of a preservation effort, and places restrictions on height and setback as well as buildings' coverage on typical city blocks (Levy, 2015).

Many communities have adopted historic guidelines that include recommendations for orientation of ridge lines, gable ends, and the density and pattern of fenestration, let alone parking and coverage restrictions, such as in Stonington, CT. (Stonington, 2019) is one such example. Innovations that incorporate both contextual standards, incentive zoning bonuses, mixed-use districts, and of late form-based approaches to zoning are all aimed at inserting flexibility and innovation into the program.

Attempting to place a massive parking structure in this setting is challenging; yet, within the more liberal zoning restrictions of commercial districts, addressing the varying concerns of height, massing, sizing, and their impact is no less daunting than in the local suburban downtown context. This is especially true when average building heights rarely exceed one or two stories, or by regulation three to four stories in suburban communities. For instance, this is the case in Madison, NJ, where a Bloustein studio study in 2005 addressed the pending transit village status for the community (Kimmerle & Robbins, 2005). This begs the question of whether zoning itself is to blame. Soule (2006) contended that zoning is

> …simply the framework that accommodates the rules that we decide to apply to land and how it is used…by targeting the right regulations for change, local communities, especially when combined with supportive regional, state and federal policies, can take steps to foster better development outcomes. (p. 377)

Normal zoning challenges are comparatively minor when juxtaposed against the exercise of more freewheeling development standards in communities seeking investment and infusion of development interests. In these cases, many of the in-place local zoning regulations are revised within the redevelopment plan leading to a situation where floor area ratios (FARs) can easily double or triple.

This phenomenon is a common criticism of New Jersey's transit village program (Wells & Renne, 2003). In most cases, the transit village structure is being built at a density far in excess of adjacent commercial and residential zones (65 units per acre or more with FARs between 8.00 and 10.00) and site assemblages encompassing multiple acres. Additionally, the burden for providing replacement commuter parking on these sites is causing massive oversizing and increases in average density of these developments to the detriment of the host community.

Morristown's recently completed three-acre transit village consists of 226 units, 8,000 square feet of retail, and 780 parking spaces. This entails a total building mass of over 550,000 sf, for a FAR of over 12.65, and a housing density of over 75 units per acre. The parking ratio (which includes replacement commuter parking) overall averages 3.45 spaces per unit. This occurs within a municipality where the average housing density is just 4.7 units per acre. At this scale, transit development projects and buildings can represent a great incursion into an existing city streetscape (Wells & Renne, 2003) and can include substantial parking structures that are over-scaled and inappropriately sized for their communities. A recent transit village development in Metuchen, NJ creates similar impacts, including a scale that completely overwhelms its host community.

For purposes of comparison, traditional eastern cities were generally modeled on densities between 20-30 units per acre. For instance, housing density in Manhattan tops 55 units per acre while density in the Borough of Brooklyn and the outer boroughs approximates 21 units per acre and matching Hoboken, NJ at 24 units per acre. In cities like Chicago and Philadelphia the average is just 7 to 8 units per acre.

What, then, constitutes high versus low density? According to the New Urbanism website, www.newurbanism.org, areas with housing densities of 30-35 units per acre and building heights ranging from four to five stories, are considered high-density. Low density implies communities and neighborhoods with two- to three-story heights and housing densities averaging between 10-15 units per acre. Of course, all of this is based on local context, transit availability, and the range of retail and recreation amenities available in a location.

Parking and structured parking plays an important role in the transit village model, where site-specific densities are allowed to rise to over 65 units per acre or more, with heights of five to six stories. Transit-located buildings in Hoboken, on the other hand, can exceed 200 units per acre. Bijou Property's recently completed Hoboken mixed-use projects at 700 and 800 Jackson Street feature 424 and 113 units, respectively, in 14 and 11 stories on a 1.80- and 1.35-acre city block. These structures achieve densities of 235 and 82 units/acre respectively, although the 700 Jackson development also includes a two-acre public park which reduces the overall average density to 112 units/acre. This remains a significant number even in an urban and transit located context.

Transit-oriented developments are of particular interest to developers and have special advantages in terms of their implied increases in traffic and movement. They tend to spawn plans that focus on increased densities in complex, mixed-use, large-scale development programs. It is in these zones that structured parking plays an important role, sustaining both development and the densities generated by the confluence of demand, transit services, and other public amenities. Further, in mixed-use settings, the placement of structured parking enables other planned uses.

The challenge in such a location is twofold: articulating at what scale and intensity of development these building programs can shape the future redevelopment context for these communities, and determining guidelines that offer direction without overly restricting creative and innovative options for these development plans.

Sollohub et al. (2007) provides an overview of potential constraints and a series of solutions in *Transit Friendly Parking Structure Guidelines: Planning Design and Stewardship,* which is directed at issues related to parking and its integration at transit sites and transit development cases. Sollohub provides design solutions that address parking at a variety of scales, as well as a list of constraints that can be adopted as guidelines. They can serve in the development of these structures as well as in the adoption of local codes to limit the height, scale, and impact of these structures on public spaces. The research is funded by New Jersey Transit in the interest of illustrating a variety of methods and forms of integrating parking into transit sites.

A common device for providing some level of control over these structures, in terms of their impact at the pedestrian level, is to maintain uniform and contextually

based two-to-four-story street-walls in downtown locations. In many cases, however, the offsetting allowance for these accommodations is height and floor area ratio (FAR) increases of a substantial nature on the inner block, or on the central components of a full block plan. Tiered much like a wedding cake, the overall effect is to absorb a significant scaled structure that many times overwhelms its neighboring blocks with awkward frontages and placement of disparate uses.

The redevelopment process

All of these public policies, land use regulations, and zoning codes are administered in a public forum: the redevelopment process. Broadly, real estate development describes the improvement of real property. More specifically, the New Jersey Redevelopment Authority website describes redevelopment as the real estate development process applied to a site that has already been improved and built upon. At a smaller scale, infill development refers to development of vacant lots in communities or urban areas that have already been developed or improved (New Jersey Redevelopment Authority, 2019, p. 1).

The redevelopment process begins with a statement of need or eligibility, drawn from various sources. This may include:

1. Increased tax levies, loss in population, as well as other demographic impacts, including deficiencies in education and loss of employment opportunities;
2. Building permit application statistics that address renovations and refits, in order to determine the amount of reinvestment occurring in a community;

3. Declining sales and rental figures, and the status of the upward or downward trends in assessments of in-place property values.

With these determinations, the first step in seeking a redevelopment ordinance at the municipal level is a declaration of an area in of need of redevelopment. A council-approved resolution making this declaration "unlocks municipal and state powers to condemn property by eminent domain, leverage tax assistance and abatement programs, and allocate direct public investments to fund a redevelopment plan and program for a district" (Lendor, 2013).

Following the declaration, the council empowers the planning board of that community to undertake a redevelopment master plan to consider alternate uses, and a future program of public and private investment in the zone. Oftentimes, roadway and sewer infrastructure, along with other reinvestments, need to occur to support the repositioning of the district to new uses. Many times, the need for parking structures to support additional density of housing and/or office uses becomes an important first step, and one which, when endorsed by the public body, is assigned to a separate parking authority to fund and build one or more new structures in the district. Because a structure such as a public parking structure can identify an independent stream of revenue from its operations, the relevant authority is empowered by state law to issue bonds and otherwise build and operate these structures without directly impacting municipal budgets.

Once approved, the council adopts the plan, and that process includes the writing of a new or revised zone code for the district that foresees and enables the uses

and improvements planned for the area. The council can go further, designating a redeveloper, whose role is to assemble parcels, provide preliminary design and planning documents, and, in some cases, either build or auction for sale now-entitled parcel, to outside development interests in order to achieve the aims of the plan.

The timeline of this process can be as short as six months or can extend for many years. At each stage of the process, public hearings are held to keep the public and other interested parties informed of the sequence of events and the actions of the public bodies, while also soliciting input and comments along the way. The process is complex, involving multiple public and private parties, as well as the landowners whose holdings - either willingly or unwillingly - are impacted by the intentions of the redevelopment act. In some notable cases, such as *Kelo vs. City of New London* (2005), local objectors to the redevelopment program sought support to avert these local actions, and in that case the arguments went to the US Supreme Court for a determination on the ability of local municipalities to force condemnation of unwilling property owners affected by the larger redevelopment plan.

Where does parking and the design of parking structures fit into this complex and timely sequence of public acts? As important as it can be, parking and the ultimate design of the structure itself often becomes a sidebar and an element or benchmark that is many times subsumed in the larger issues and debates that occupy the agenda of these very high-profile and contentious municipal acts.

Further, as Robert Goldsmith has confirmed in the introduction to this dissertation, the consideration of parking frequently fails to receive the full width of

attention it deserves as the first and perhaps most vital component of the redevelopment plan (Goldsmith, 2019). Certainly the issues of parking size, scale, massing, visual quality, and placement receive varying degrees of focus by the range of players involved in the process, and, as might be expected, cost becomes an overriding criteria to these public bodies, who for all intents and purposes are acting on the public's behalf.

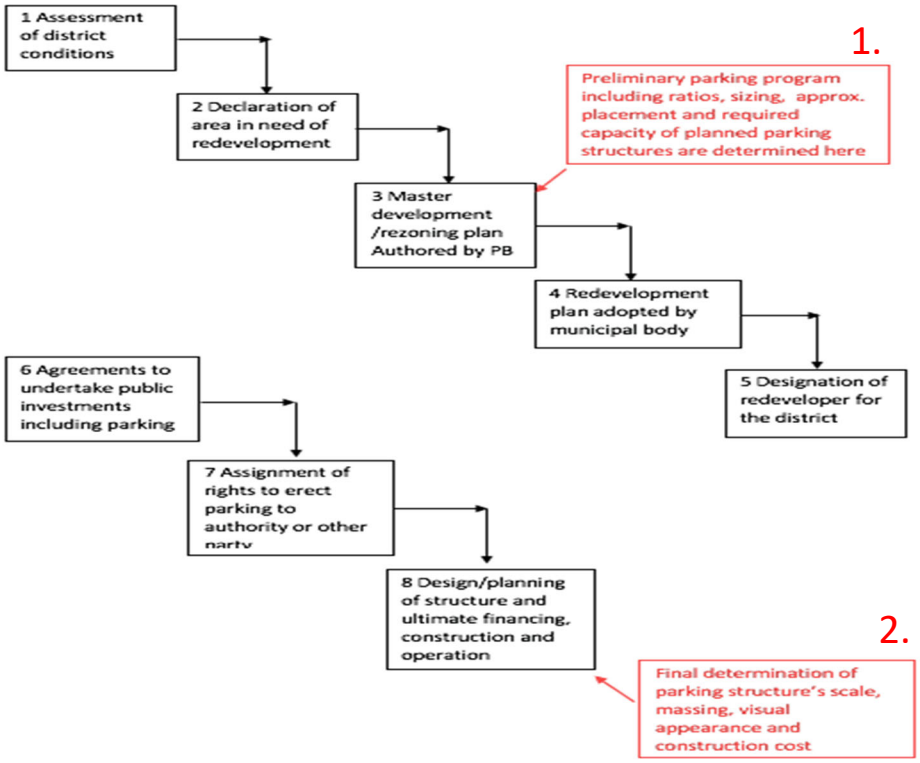


Chart 2.5. The redevelopment process and parking

Chart 2.5 shows how parking fits into the overall process.

1. Planning board review of concept plans sets the overall density in the zone, parking use, and ratios as well as the ultimate planned capacity for the parking program (size, scale, and potentially placement are at issue).

2. The negotiation of the redevelopment agreement is the next opportunity to impact the parking program. Final sizing, scale, massing, visual treatment, and the details of placement and integration into the street system are at issue in this stage, as well as the ultimate budget and impact on the economic metrics of the redevelopment plan.

This dissertation contends that, at the critical stages of the redevelopment process shown above, providing a basis for the valuation of all five criteria outlined is vital. Incorporating standards that address the five subject criteria directly gives both the planning board and the council the tools to direct the design and placement of parking structures and to access its future role and utility in the larger redevelopment program. Those standards will also allow the engaged parties to assess the five criteria directly and comparably in direct relation to other important considerations, such as cost.

Parking as an industry: Engineering and management systems

The literature regarding structured parking as an engineered object focuses on efficiencies of form and layout, management, and inventory techniques to extend its usability, and as public infrastructure. Industry sources, such as Walker Parking Systems (Walker Parking, 2017), have developed precise means for maximizing parking outcomes and limiting costs. The techniques for the design and construction of these systems include sophisticated analysis of usability, constructed volumes and areas, circulation factors, and the ultimate capacity of these structures. A multi-billion-dollar industry, it has honed its approach and systemized much of its operations from a constructability

perspective. Walker Parking also provides concise overviews of the structural and planning issues involved in maximizing these forms from an accommodation and efficiency point of view (p. 2).

Darius Sollohub addresses the technical and aesthetic challenges in structured parking, noting that they have the potential to become extremely expensive. As he states, “costs can spiral due to a loss of efficiency, and at levels that go well beyond the already-expensive unit costs experienced for this building type” (Sollohub, et al., 2007). Explorations of the efficient planning and design of these structures also appear in the previously referenced *The Architecture of Parking* (Henley, 2007), and *The Parking Garage: Design and Evolution of A Modern Urban Form* (McDonald, 2007). All of these texts provide an overview of parking as a built form, including its overall complexities and technical difficulties.

Management and enforcement are intimately linked in downtown parking programs. The control of inventory, timed use, and enforcement is linked to making an overall parking program work for retailers, residents, customers and visitors. The City of Miami, FL has a technology-based means of enforcement that stresses short-term on-street parking, and decks to provide overflow for employees and residents (Miami Parking Authority, 2013). Both Henley and McDonald address management of parking space inventory, seeing it as a major contributor to the ultimate size and scale of parking structures (Henley, 2007; McDonald, 2007).

Sophisticated technologies have been developed for controlling and managing parking. Such technologies can minimize the size of structures in redevelopment zones

by increasing the inventory, and overall use of available spaces (Weant, 1978) and (Willson, 2015). Smartphone applications that communicate available spaces to the parking public help achieve higher utilization rates as well by maximizing the use of in place capacity. Future applications for these systems that integrated rideshare, drop-off, and pick-up are also emerging. The integration of these access systems is changing the entire platform for parking accessibility (WSP Global, 2017p. 28).

An article in *Planning Magazine* (Dorset, 2017, p. 1) emphasized the major changes in management that are also allowing communities to re-price parking in real time, providing complete control over how and in what ways customers use the in-place parking inventory—from street spaces in the shopping district to more remote structured parking for long-term use. The utility of parking as a community asset is transforming in light of changes in technology and communications.

Parking as an industry: The economics of parking

The cost of parking can be significant impacting the total costs of development, subsequent rents for users, and ultimate returns for investors. Mediating those impacts is critical to structuring a redevelopment program. Costs can be also impacted by different construction approaches and deck configurations (see Appendix D diagrams), but more importantly by properly determining the types of parking and the proper ratio of spaces to be developed—whether for office, retail, or residential uses.

The economics of parking are addressed in two texts. The first, *Parking Structures: Planning, Design, Construction, Maintenance, and Repair* (Chrest, Smith & Bhuyan, 1989), examines the cost, financing and operations of parking structures versus

flat lots in an array of financial models that test for monthly overall cost per space. In *Parking Matters: Designing, Operating, and Financing Structured Parking in Smart Growth Communities* (Bier et al., 2006, p. 73), the authors tested similar financial parameters overlaying the use of Payment In Lieu Of Taxes (PILOT) subsidies in a publicly bonded financial model to derive similar monthly costs.

To help illustrate the potential impacts of these approaches, a pro forma model is incorporated into this dissertation. This model incorporates controls for land cost, development area, costs of parking in various forms (i.e., surface, decked, and garaged), as well as building and site work costs.

With these inputs, the model reports on net rents, yield, cash on cash returns, overall project returns, and Internal Rate of Return (IRR). It also has the ability to reveal results in two forms: (a) rent differentials given constant returns; and (b) return variables for a fixed, flat-rent projection. In the first scenario, the rent effects of parking are revealed for constant returns; in the second scenario, rents are kept flat in order to show the effect on the developer's returns on investment (models are accessible through use of the Dropbox link contained in Appendix A).

The model, presented in the Findings section, can also uncouple the costs associated with parking from the general development program to reveal its true impacts on both rents and returns. The decision to include or exclude the cost of parking in unit rents is highly debated and is an important point of decision-making in all development financial pro forma and analysis. Testing various scenarios enable the

prediction of a variety of outcomes, while they also report on a range of project inputs and constraints that can have public policy implications.

These inputs were, in part, drawn from responses from the focus groups assembled for this dissertation. Respondents were asked to select from several preferred upgrades and enhancements to the prototypes. The Findings section features several of these alternate scenarios to predict their actual economic impact for the redevelopment program under consideration. This section includes a level of insight rarely revealed in the literature and is a unique and important contribution of the research effort.

Part II: Emerging trends

Three additional areas of discussion impact the future state of vehicle ownership and usage—and with them, parking—and each warrants inclusion in this literature overview. They consist of:

1. Demographic and generational changes impacting parking demand and structured parking;
2. Transitions in mobility, including the adoption of various ridesharing and vehicle-sharing programs and applications, and the development of autonomous vehicles; and
3. Evolving development models that represent a fundamental change in settlement patterns leaning towards a more urbanized and densified living environment.

Generational and demographic changes

The activities and choices of the millennial and baby boomer generations represent shifting cultural trends that have the potential to be transformative. These generational priorities and perspectives, as well as technological innovations—including ridesharing and other application based alternatives offer transportation options and convenience and each has a particular implication for car usage and ownership, and with them demand for parking.

The impacts of these new ideas are a growing area of literature. *Uber's New Wave of Urban Design: Are Cities Ready?* (Nisenson, 2015) addressed this topic, as did *Me++*: *The Cyborg Self and the Networked City*, and *The Intelligent City (2007),* Mitchell (2007). Mitchell's text advocates for networked places and portends major transformations in how urban infrastructure is adapted to these coming changes in two of several related and themed texts. Mitchell is a leader in examining the impact of networked systems on traditional understandings of urban space, place, systems, and infrastructure from his at post at Massachusetts Institute of Technology's (MIT's) Media Lab.

Willson (2015) explains that "the demand for differentiated parking markets, pricing and service levels will continue to grow" (p. 19) given millennials' preferences for urban living environments, embracing walking, biking, transit, and car-free lifestyles, and choosing to delay getting driver's licenses". The reduction in the number of persons with drivers' licenses was also reported in a recent University of Michigan Transport Institute report (Sivak and Schoettle, 2016). On the other hand, age-related

physical limitations curtailing driving among baby boomers and older generations is also impacting parking demand.

"It appears that younger people are willing to treat transportation as an on-demand service, rather than paying the fixed price of a car," according to Scott Kelley in an article on the Wharton School's web site - Wharton Knowledge. Kelley is a researcher with the University of Michigan's Energy Institute (Wharton School, 2017). Mary Smith of Walker Parking describes how changing demographics and changing work/business models stand to transform private vehicle ownership over the next decade. Cars parked for 23 hours per day will transition from private ownership to fleet service platforms where 18,000 vehicles will service a population of 120,000 people, an audience that represents the 43% of the population that currently drives less than 70 miles per day. That yields a ratio of 0.15 vehicles per person, or 0.36 per household, and owned by a consortium or as a public/private service offering (Smith, 2013). A recent survey by the American Public Transit Association (APTA), asked Millennials to rank their mobility preferences on a scale from 1 to 5. Responses were as follows: 2.24 for driving a car, 2.73 for walking, 4.34 for bus, 4.34 for bicycle, and the highest rating, 4.90, for trolley (American Public Transit Association, 2018).

Such surveys depict a generation of Americans currently in transition to becoming the dominant force in the market and responsible for changing many of our assumptions and definitions about living patterns and lifestyles. Decidedly urban, the millennial cohort leads the nation's renewed focus on urban places. The repositioning and redevelopment of peripheral cities within most major metropolitan areas can be

traced to their emergence.

These trends are assumed to be self-sustaining, but that is not certain. Now at their marriage and child-bearing years, millennials have yet to demonstrate whether they will follow the patterns of their parents' generations and flee to the suburbs; instead, they may find new ways to adapt and accommodate their current urban lifestyles. Millennials, however, are not the only ones who are growing to prefer urban living. Baby boomer retirees are increasingly eyeing urban living in major American cities as their final destination in retirement and later life.

The southernly shift of seniors seeking milder climates and lower taxes in order to sustain retirement incomes is a historic fact (this "snowbird" phenomenon has been well documented, including the sources cited here). The outmigration of seniors from states like New Jersey parallels a trend observed in other highly taxed, urbanized states. Writing for NorthJersey.com, Linda Moss reported in 2017 that "For the fifth consecutive year, New Jersey has the dubious distinction of ranking as the #1 state residents have left behind" (Moss, 2017, p. 1). "We've actually seen this out-migration trend for several years and it now includes millennials. In many cases it is due to the "very, very high cost of living in New Jersey particularly for retirees," noted Eric Keifer in an article for NJ Patch (Keifer, 2017, p. 1).

An opposite trend has emerged that includes migration, at least on a part-time basis, to an urban, or urban-like, center. "Seniors are participating in the well-documented mass migration to urban centers… 87% say a shorter commute to work is a major reason for their move to the city," reported Tim Evans of New Jersey Future.

Evans explained that this has as much to do with limited options in terms of downsizing lifestyles in the suburbs, stating: “It’s a housing diversity problem as it is an affordability problem... …about 32% of New Jersey towns did not score well on any of the three Smart Growth indicators, making them unattractive to millennials… and aging boomers” (Evans, 2017, p. 1).

Another reason that dual-income empty-nester households are seeking a foothold in the city is to access both cultural and educational offerings. The downsizing of baby boomer households is taking several forms, including in-town suburban downtowns that are now being cited as “new urban clusters” throughout suburban America. The impact of this trend on car ownership in urban places is not known.

Regardless, lifestyle adaptations that accompany both sets of generational groups are demanding new and inventive ways to picture both public services and the private amenities redevelopment investors offer to attract both groups. Amenity packages in typical urban mixed-use mid- and high-rise developments run a wide gamut, as more square footage and greater operating costs are devoted to these key marketing offerings.

All of these trends contribute to the scale of change in progress, and drive both for whom and in what ways urban and suburban spaces are planned and structured. The rates of private vehicles and ownership (as well as replacement or opting for other choices when financial resources are strained) will undoubtedly effect parking programs, systems, and structured parking in particular. Goldsmith and Melnak comment on the implications and direct impacts for structured parking. “Those looking

to finance the construction of such facilities would thus be best counseled to account for what many of these experts believe will be a seismic shift in the way people get around", (Goldsmith and Melnak, 2017, p. 46) .

Technological advances and transitions in mobility

The modern age represents huge transitions in terms of mobility, one perhaps not seen since the emergence of the horseless carriage in the 1920s. Primary contributors are ridesharing applications, the development of autonomous vehicles, and the Millennial cohort's view of transportation as more of an on-call service than a fixed possession.

Both the auto industry and Wall Street are making significant investment in these vehicle types and service programs. Although the driverless vehicles that General Motors CEO Chuck Stevens stated would be on the street by 2019 did not emerge, Stevens was quoted in the *Wall Street Journal* as saying that the service sector is an investment opportunity which, when scaled, represents a total addressable market of several hundreds of billions of dollars (Colias, 2017, p. 1).

Although it is not clear when all of these advances will be consumer-ready, the infrastructure of mobility and transit are transforming. The fundamental practices that define parking structures are in transition as well. These include whether to upsize or downsize; to implement self-park, valet, or self-guided systems; the impacts of mixed-uses and conversions; as well as the entire concept of merging transit. The scale of rethinking and reinvention is not restricted to the parking structure alone, but applies to the entire range of regulatory requirements that surround private vehicles, their use,

deployment, and utility.

For instance, Atlanta, GA recently passed a multi-million-dollar bond ordinance to deal directly with these impacts, including the creation of curbside pick-up zones and other strategies directly related to ridesharing service. The Atlanta Journal-Constitution cites a demand of 8,000 daily airport Uber and Lyft pick-ups and drop-offs as one of the reasons for this investment (Yamanouchi, 2018, p. 1). “Uber’s innovative business model is outpacing many of the laws regulating its industry…it is going to take the regulatory system some time to adjust,” according to Youngme Moon in a Harvard Business School Case Study (Moon, 2015, p. i).

Such studies have expanded the definition and scale of the transit changes that are just getting underway. A 2015 study by Sapienza University of Rome, a project of Citimobility, envisions the complete transformation of transit and mobility systems in what they term a “cybernetic fully networked city” and the development of a cybernetic centered system for transit. (Alessandrini et al., 2015) This point of view parallels Mitchell’s 1999 text, E-topia (Mitchell, 1999).

A 2013 McKinsey Consulting report projected that the majority of the overall growth in the auto industry over the next 20 years will be focused in Brazil, Russia, India, and China, as well as other nations of the emerging world (Gao et al., 2013). The report states that the condition of roadway infrastructure is critical to the transition to autonomous vehicles in those nations. Such vehicles require detailed mapping, stable roadway systems, and related infrastructure for digital recognition. These are limitations for emerging nations, yet they also constitute a potential advantage; the build-out that

this future infrastructure requires can be programmed out-of-the-box for a planned autonomous future.

Emerging nations have a huge stake in adopting autonomous systems. Chief among them is avoiding the common mistakes made in the massive investment in the developed nations for private vehicle infrastructure over the last 70 years. This ranges from investment in vehicles themselves, multi-lane superhighways, roads and bridges, to car parks, garages and signal systems—as well as public investments in Emergency Medical Transport and other response systems for vehicle accidents and injuries.

A follow-up 2016 McKinsey Consulting study reported that by 2030, 10-15% of all vehicles produced will be fully autonomous (Hans-Werner Kaas, Mohr, & Collins, 2016). These researchers noted that just 10 years ago, the dialogue was about electrification and battery sizing and efficiency; it is clear that the modern issue is digital in dimension. The analogy being advanced is that like the computer industry's shift from hardware to software, it seems the auto industry—in terms of both investment and value—will transition to a service platform offering enhanced mobility packages of multi-dimensions. Service platforms ranging from local to long-distance travel options, and vehicle types that range from summer convertibles to winter SUVs are all keyed to the day-to-day changing requirements of drivers and travelers alike.

The expected 30% growth in the industry relies on this transition from manufacturing to a service platform, even while overall sales and production in numbers of vehicles are expected to diminish. Roughly $1.3 trillion in escalated value is being keyed to this transition. McKinsey also remarks that at this time, the interest in

autonomous vehicles is supply-driven, not demand-driven. Investment in this sector represents an industry seeking a market, rather than consumers redefining their needs.

Some of the larger areas that policy needs to address going forward are addressed in Spivac's (2019) article from the American Planning Association Journal:

1. Cities already have more than enough parking. [citing the Mortgage Bankers Association survey of five American cities].
2. Mobility preferences are shifting to a renewed preference for transit and the adoption of smartphone-enabled ridesharing services.
3. Actual demand for parking is reducing to one car per family or less, consistent with demographic trends in the millennial and Gen X cohorts.

These last two changes have been confirmed as well by Richard Dubrasich, a land-use attorney, who states that "trends such as the increasing use of electric, and in the future, driverless vehicles, as well as car-sharing and ride-hailing systems, also need to be taken into account" (Dubrasich, Cox, Castle & Nicholson LLP, 2017, p. 1).

A recent article by Reid Ewing (2018) of the University of Utah cites several projections further supported by the American Planning Association's *Planning for Autonomous Vehicles* (American Planning Association, 2018). Ewing provides several noteworthy predictions, including the projection that by 2040, 50% or more vehicles on the road will be fully autonomous. Further, Ewing reported a projected 43% reduction in the number of privately-owned vehicles, as well as the expectation that "one shared autonomous vehicle accessible from a variety of online applications will replace anywhere from 9-11 privately owned vehicles" (Ewing, 2018, p. 38).

Two of Ewing's stipulated implications stand out:

1. Reductions in the demands for, and changes in, the location of parking; and
2. New redevelopment opportunities in urban and suburban locations as open parking lots and structured parking becomes obsolete (Ewing, 2018, p. 38).

These expected changes in the placement and utility of parking are especially important, as parking can go unappreciated as the device that currently unlocks urban density in central city, suburban downtown, and urban cluster settings. Even that assumption will be called into question if these trends do in fact materialize.

Time will tell if the full integration of these systems plays out; however, a move towards accommodating these trends, and adapting structured parking accordingly should become an integral part of planning efforts today. Those accommodations will enable the seamless and economical incorporation of new modes and styles of mobility into redevelopment plans going forward, rather than trying to adjust midstream. To that end, the settlement, mobility and demographic changes cited above are explored in greater depth in this dissertation's Areas for Future Research.

Conversions, adaptations, and reuse

Beyond creating structures that have the potential to be transformed in the future to other uses (i.e., the flat-plate structures without ramped floors), parking structures have an immediate potential for reuse when these structures are sited well. With an eye towards eventual habitation, considerations such as placement in the streetscape and access to light and air become more important. These issues are explored in the focus-group sessions conducted for this dissertation, and the responses

range from simple straightforward conversions for storage and industrial uses to more complex recreation and residential modifications.

An emerging trend is the development of the freeway deck parks, such as those seen and recently incorporated into redevelopment efforts in St. Louis and Boston. Recreation integrated into the abandoned infrastructure of parking is a logical extension of the need to find future accommodations for transportation infrastructure. Integration of active and passive recreation zones in the downtown core can be seen in the Rose Kennedy Greenway capping the former Big Dig in downtown Boston.

Similarly, a recent article in the American Planning Association's Planning Magazine notes that "Dallas, Denver and Pittsburgh are at the forefront of this trend of using deck parks to reunite neighborhoods" (Spivac, 2018, p. 1). Spivac also cites similar efforts in San Diego, Seattle, and St. Paul. This trend to recapture spaces formerly and exclusively assigned to transportation infrastructure will ultimately extend to underutilized parking structures as demand diminishes.

Providing other public uses in connection with parking is another means of responding to changes in demand. It also points to the possibility of finding a broader cultural understanding of structured parking and how it fits into the landscape of daily life. Princeton, New Jersey's new library incorporates a significant parking deck with housing and retail. Other strategies include turning significant parking structures at transit into public recreation facilities, including ball fields and other public amenities. In Delray Beach Florida, a new IPIC theater complex is housed essentially in a parking structure but consisting of a mix of entertainment, retail, and office space. (Herman,

2019). *Build a Better Burb* (The Rauch Foiundation, 2011), a website that examines redevelopment options in Long Island communities, has several models for the integration of parking at major transit hubs. Likewise, the University of Colorado has recently built a major on-campus parking structure complete with a NCAA-regulation soccer fields on the upper tier. Other joint uses can be incorporated, and there are no limits to the applications that can benefit from well-placed parking structures, if properly and sensitively planned.

Using building types of the past era as models to reinforce or reinvent new uses was a common method in the 1970s transition of downtowns into entertainment zones in cities such as Boston, New York City, St. Louis, Baltimore, and San Francisco. Whether transitioning existing structures to new uses or using them as the basis for the creation of new structures or forms, precedent provides a means to re-envision—if not reinvent—past-built solutions.

The reuse of historic structures and their reinvention in contemporary uses in fact has a foundational history in the United States cityscape. The reuse and reinvention of urban spaces in the European sense is a long-standing traditional approach. Particular attention in this context is drawn to the European invention of reconstructing central city squares as underground parking; the logic is intuitive—bring parking to the center of the city where it is needed. In fact, public squares in the Netherlands are so important that they have their own Facebook pages.

Changing settlement patterns

The Regional Plan Association's 1996 report, *A Region at Risk*, was issued in an

era that also saw significant federal relaxation of standards for the use and reuse of toxic or contaminated lands for new uses (Regional Plan Association, 1996). Those public policy statements resulted in a greater focus on redeveloping former industrial, port, and urban zones for new uses, and for accommodating housing, community, and neighborhood development. Coupled with academic and research work (large portions of which occurred at the Center for Urban Policy Research at the Bloustein School), an overall trend away from sprawl and focused at the revival of urban lands was borne in that era. The build-out of areas like Hoboken, Jersey City, and the outer boroughs of New York has since progressed and is approaching potential saturation as densities far outstrip in-place sewer, electric, water and public service accommodations including schools and recreation sites.

Looking back upon the Regional Planning Association's report, another set of recommendations comes into focus—namely, the redevelopment efforts sited at points of transportation and transit connection within New Jersey Transit's Transit Village Program. This program is but one of several public policy programs that are a by-product of the overall public mandate to refocus on the urban core envisioned in Regional Plan Association's 1996 report. The report also cites so called "urban nodes" at important interstate junctures, which are just now emerging as important points for development activity.

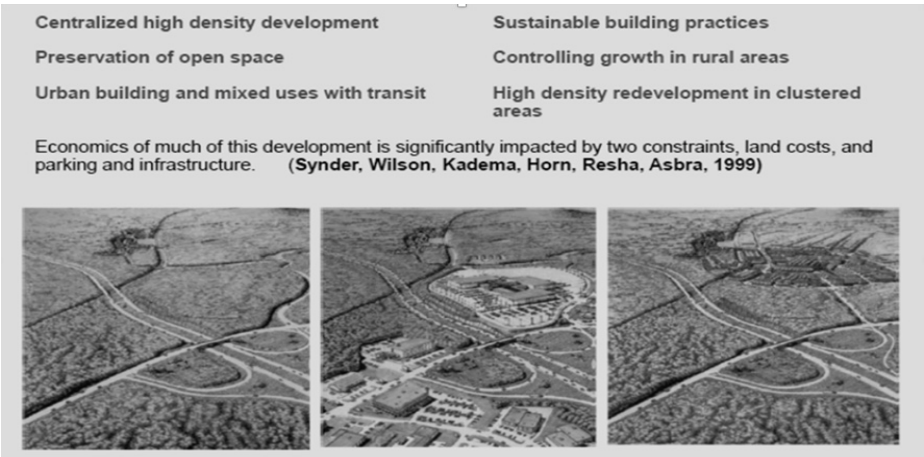


Chart 2.6. The exurban clusters or nodes – Rural and suburban redevelop (Regional Plan Association, 1996, p. 122-124).

Consistent with this trend are the repositioning of many Manufacturing, Research and Development sites throughout New York and New Jersey to new 24/7 communities. The redevelopment of the former Hoffman LaRoche Research and Development (R & D) campuses in Nutley, NJ and the former Grumman Aeronautics site on Long Island serve as examples. Additionally, other locations around the nation are all undergoing major reinvestments as mixed-use commercial, residential and retail developments.

These sites are emerging as major areas for densified communities at ratios heretofore not experienced. The drive for redevelopment in industrial, research, and office parks previously only accessible by cars and buses/jitneys has placed increased scrutiny on the kinds of parking accommodations that need be included, on both a flat lot and structured parking basis.

The drive towards density is being impacted by several constraints: development in these areas must assume higher land values purely based on demand; costs related to the demolition of significant former on-site structures; dated infrastructure requiring upgrades or outright replacement; and the burden of environmental cleanup in some instances.

Although these factors add to the complexity of such development, they are not the only determinants. The desire to create urban-like density in these more remote developments also coincides with lifestyle changes. These changes are reflected in the demand for mixed-use settings and active/engaged living environment that replicate urban options, to a degree, but which are available at an overall cost of living that is more affordable to a larger segment of the population. The examples cited above will provide urban densified living environments at a lower cost than their counterparts being built in already developed areas like Jersey City, Brooklyn and other parts of the NYC metropolitan area.

A review conducted for this dissertation of a half-dozen mixed-use multi-family proposals located in the tri-state area indicates a drive towards densities in excess of 45-55 units per acre, at floor area ratios in excess of 7.0-9.0. These numbers conflict with former suburban densities that rarely rose above 15-20 units per acre. They stand to create a greater burden on local highway and roadway infrastructure, which was neither planned nor sized to anticipate the subsequent volumes that fall out of these figures. When this occurs on sites without proximity to transit accommodations, even larger impacts can be expected. The role for structured parking becomes even more

problematic in these instances. Without the use of shared parking, and other modifications to state and local standards, parking ratios can then spiral.

Urban repositioning

Richard Florida calls for an integrated urbanism in his forward to Dunham-Jones and Williamson's 2011 text, *Retrofitting Suburbia: Urban Design Solutions for Redesigned Suburbs*. Florida noted that suburban renewal relies on "two key and related factors—walkability and density." (Florida, as cited in Dunham-Jones and Williamson, 2011, p. 1-4). Florida referenced urbanist Jane Jacobs and economist Robert Lucas by explaining, "The clustering of people and economic activity is the basic engine of economic life" (p. 11).

As a backdrop to a discussion about emerging and densifying suburban downtown districts and new urban clusters, Florida's comments underscore the social and political motives in the development of new urban spaces outside the traditional downtown setting. "All of this is not happening everywhere. It is happening at specific nodes ...generally where the transportation infrastructure (usually with some improvements) can support it... the *densified retrofits and countless revitalized small-town Main Streets* [emphasis added) are joining the edge cities as increasingly significant suburban activity centers" (p. 9). Williamson terms this trend "incremental urbanism," a phrase that has gained currency over the past few years in referencing redevelopment and new development efforts on the periphery of central cities.

In Emily Talen's 2015 *Retrofitting Sprawl: Addressing Seventy Years of Urban Form*, David Dixon, the urbanist and planner, now with Stantec, stated that the Garden City movement assumed that suburbs would remain discrete communities. Thanks to the automobile, however, "suburban communities did not need a nearby commercial district, and thus the concept of a suburban downtown disappeared for almost 50 years" (Talen, 2015, loc. Chap. 4, para. 7).

Of the "new communities" like Reston (outside Washington, D.C.) and The Woodlands (outside Houston) which had roots in the Garden City movement, Dixon points out that unlike their forebears "they were car-oriented, often characterized by lifeless streets; they served entire regions; and they focused *on commerce, not community* [emphasis added]" (Chap. 4, para. 8). In an allusion to Jacobs and Lucas's perspective on urban spaces, these authors assert that new communities succeed today by "satisfying a growing demand for places that offer the benefits of being part of a community. *They increase economic value by creating social value* [emphasis added]" (Talen, 2015, Chap. 4, para. 8).

The subject of the Garden City movement as a model for American suburban development in the fifties through the seventies is addressed in Chapter 2 of this dissertation and acknowledges that the development of American suburban places is a dysfunctional adaptation of the Garden City form, which was advanced by Ebenezer Howard in the late 19th century (see further discussion in the notes section of this chapter).

As for the common aspects of these new transforming suburban communities, Dunham-Jones and Williamson points to their hybridity and that they "reflect aspects of both centeredness and decentralization" (Dunham-Jones & Williamson, 2011, p. 13). This consists of, among other things, suburban parking ratios and urban streetscapes; urban building types filled mostly with suburban chain retail outlets; and urban qualities delivered at suburban costs.

Addressing the role that parking plays, Talen suggests that the problems of proximity and dimension can be solved by "reducing the proportion of building area used for parking… …thereby significantly reducing overall building dimensions (Williamson, 2015, p. 103). These authors also suggest that increasing the base affordability of housing in such areas can be enhanced by locating residential parking remotely—that is, decoupling it from the buildings it serves, thereby separating that demand from specific user requirements. Parking allocations are no longer assigned to individual housing units (i.e. parking becomes a shared resource and reservoir on site). This perspective echoes Donald Shoup's work in this area.

Summary and research questions restated

As this literature review shows, the complex nature of the redevelopment process itself, and the various priorities, perspectives, concerns, and levels of expertise of the professionals, stakeholders, and decision-makers engaged in that process, all impact how structured parking is implemented. Because these different frameworks cannot be integrated into one decision-making path that reflects an understanding of the city as "a total field," parking does not consistently receive holistic consideration.

Given parking's role as the first publicly built structure which shapes many redevelopment zones, there is a clear need for new standards, guidelines, and strategies to guide its implementation, design, and deployment. This dissertation proceeds from the point of view that the "route" to improving structured parking in a variety of redevelopment contexts is to establish standards based on criteria that are neutral, non-situational, and design-based. Critically, these standards hold the potential to improve the complex relationships and patterns within the urban setting and to unite them into a single whole, fulfilling Kevin Lynch's call for research that details and discovers the patterns and sequences of a united "whole" in these urban environments (Lynch, 1960, pg. 158).

To that end, the research phase of this dissertation answers the following two questions:

Research question 1 - Restated

Research Question 1: *How can the performance of structured parking be improved by examining the following essential design criteria: size, scale, massing, visual presentation, and placement?*

Research question 2 - Restated

Research Question 2: *How can these considerations be balanced with the following larger and evolving areas of concern: reduced private vehicle usage and parking demand, demographic and social trends, generational shifts, and changes in overall mobility and settlement patterns*?

The means and methods for answering these questions form the basis for the next chapter of this dissertation.

SUPPLEMENT TO LITERATURE IN AREA OF URBAN DESIGN THEORY

The architecture and urban design theory section of the literature review compromises three areas of interest. This chapter covers the five criteria that guide this study: sizing, scale, massing, visual representation, and placement (captured above in the body of text). The review also discusses rationalism versus relativism in architecture and parking design. In the chapter's supplement, larger historic traditions and epistemological perspectives are explained.

Rationalism versus relativism

As architectural and planning theory has vacillated from rationalism to relativism over the past 60 years, so have approaches to parking structures changed. The five eras profiled present the results of this dynamic change.

Rationalist parking structures

Rational planning theory posits that direct causal relationships can predict and translate into desired outcomes that are both positive and progressive (Leoveanu, 2013, p.44). Relativism, conversely, operates from the position that outcomes are unrelated and occur by random chance. In the absence of a larger mandate to fulfill, relativism's outcomes may be self-referential and self-reflective. Parking's rationalist beginnings in the post-war years leveraged the forces of capitalism, armed with rationalist-based Modernist dicta, to rebuild American cities. This was accomplished through a massive federally funded urban renewal program.

The modernist forms depicted in Figure 2.7 date from that era and convey scale

of this investment in housing, highways and civic infrastructure all pointed towards the creation of “model cities” where time-worn and ghettoized urban zones once stood.

Figure 2.7. Left to right: New Haven Civic Center, New Haven, CT (1972) by Roche Dinkalou, Paul Rudolph’s Temple Street Garage, New Haven, CT (1961), and Bertrand Goldberg’s Marina Towers in Chicago, IL (1964). The latter, with mid-stack parking between the street level and residential units above remains a template for downtown parking.

Post modern “decorated boxes”

The passing of time, and an overall abandonment of rationalism in many disciplines —literature and the arts, as well as architecture — translates to a period where parking adopted a post modern cant. As its label implies, post modernism is steeped in a position opposing modernist rationalism and progressive thought.

Figure 2.8. Left to right: Frank Gehry’s Santa Monica Place parking structure, Los Angeles, CA (1980); Stanley Tigerman’s downtown Chicago garage with its façade fashioned from the pattern of a Rolls Royce grill, Chicago, IL (1984); the equally thematic Kansas City Central Library parking structure, Kansas City, MO (2004).

The structures depicted are rhetorical. Although they reference their modernist forebearers, they are freestanding and self-referential incarnations. “Decorated shed”

wrapped with independent decorative screens, they are generally disconnected and isolated from their contexts.

Integrated parking in Smart Growth and transit village programs

Smart Growth and Transit-oriented development (TOD) represent a new era of rationalist progressive planning thought that embraces positive aspirations. Smart Growth and Transit-oriented development (TOD) based programs support sustainability and conservation with an eye towards environmental stewardship. Smart Growth communities seek to minimize the negative impacts of development by encouraging densification and combining and sharing resources, mixed-uses that also promote walkable and transit accessible communities, and a structure that advocates for healthy lifestyles, diversity, and social support (Smart Growth America, 2020, p. 1). This ethos is expressed in the form of anti-sprawl and Transit-oriented development (TOD) legislation focused on urban redevelopment and reinvestment.

Figure 2.9. Left to right: Princeton Library/Spring Street Garage, Princeton, NJ (2005), shields a traditional multi-story deck from view in a downtown location at a moderate scale. Morristown, NJ's transit village, Morristown, NJ (2009), required a 100% replacement of on-site spaces forcing a design that significantly exceeds local zoning height and density limits.

The structures above represent the Smart Growth principles of sustainability, mixed-use environments, and embracing consolidated and densified transit-focused

redevelopment goals. Rationalism and progressive planning principals are also embodied in these incarnations.

Vanity building trends and starchitect renditions emerge

A return to relativism in the late 1990s put the focus on architecture as a manufactured product—in this case, in the creation of high-design trophy or vanity buildings. Such structures are self-referential, if not self-indulgent, and disconnected from both the structural forms encased and the contextual forms of the urban settings they serve. The application of a brutalist approach to the Lincoln Place garage is incarnation of this approach—in this case, a gesture to a "modernist revival."

Figure 2.10. South Beach Garage, Architectonica, Miami Beach, FL (1997), Lincoln Place Garage, Herzog and de Meuron, Miami Beach, FL (2009), and the Santa Monica Convention Center Garage, Moore Ruble Yudell Architects, Los Angeles, CA (2006).

Emerging trends associated with landscape urbanism and parking's role in transportation infrastructure

A 21st century approach to urban rebuilding takes on larger concerns including climate change and other issues of environmental quality and sustainability. This approach also entails creating transportation linkages and sustainable urban systems and the need to serve such larger concerns with links to Landscape Urbanism and other progressive approaches to rationalism.

Figure 2.11. Left to right: Yokohama International Passenger Terminal by Farshid Moussavi, Yokohama, Japan, (2002), the Milwaukee Art Museum, Milwaukee, Wi. (2001) and Liege's Guillemin's railroad station, Liege, Belgium. (2012), both by Santiago Calatrava. All point toward a future for parking's integration with transit and other community-based uses.

These forms refer back to the origins of rationalist planning in the forties and incorporate modernist visual aesthetics. This is evident in Santiago Calatrava's incorporation of long-span and soaring architectural forms in civic infrastructure including bridges, museums, and integrated transportation centers.

Returning to modernist notions and forms in this era

Landscape urbanism and its advocates embrace the ecological challenges of this age, population growth in urban areas, and changing settlement patterns. Their progressive agenda harkens back to the years of post-war modernism, when urban planners sought to rebuild cities and countries with a positivist and progressive agenda. Putting aside the self-assured and singled-minded dicta of modernist formulas, both eras share a larger vision and a broader intention.

Paul Rudolph's vision for the Temple Street Garage, built in the early 1960's, entailed "tripling its size and extending its length across a recently built interstate connector" (Freeman, 2010, p. 134-136). This planned effort anticipates the need to link to other districts in New Haven, and to a recently demolished market district that had been the subject of an urban renewal clearance program in the previous decade. While

perhaps misunderstood in its time, Rudolph saw this "megastructure"— as the "integration of building forms with raised and lowered throughways and parking structures"— as serving the role of vital infrastructure (Moholy-Nagy, Rudolph & Schwab, 1970). This expansion sought to unite all elements of the city and to accommodate pedestrian movement, housing, retail, and traffic by the development of multi-level service and delivery platforms that separated those uses from pedestrian flows and business and recreational uses in the city space.

While speaking to the larger subject of city planning and the automobile, Rudolph notes "the scale of the automobile and its configurations are alien to traditional building types but are potentially powerful unifying forces" (p. 114). As mobility transforms and urban population grows, looking-back-to-look-forward is warranted. Defining a place for parking in the rubric and larger intentions of Landscape Urbanism holds potential that can lead to a positive and integrated mission for parking in the future.

Towards a more central role for parking

Henley (2007) and McDonald (2007) each addressed the significance of structured parking in the public realm. They both agreed that the present inventory of in-place parking structures falls far below customary design standards and that they are ripe for a re-evaluation and redefinition of this building form. As Henley, a British architect, observes:

> The demise of the large-scale project has undoubtedly altered the status of the car park...We have become ashamed of the scale and sculptured appeal of the multi-story parking structure. As a result, parking structures are increasingly concealed underground, the abstract forms removed from the townscape. In

> existing cities, underground car parks are less likely to be situated beneath buildings, especially historic ones and are instead put under parks, squares, and streets. (Henley, 2007, p. 15)

McDonald, who acted as a consultant to the National Building Museum's exhibit, House of Cars, and whose work helped outline the content of the exhibit, envisions for structured parking a greater role in a community than just vehicle storage: "a parking garage functions as a connector in two senses for travelers, it marks a transition point of movement sequence, the point where drivers and passengers switch to one form of the mechanical mode of transportation and the human mode. Although this passage is one of the least explored issues in contemporary architecture, it is central to modern society" (McDonald, 2007, p. 102). She continues, "the need to mediate the scale of man and machine remains *the greatest challenge in parking garage design* [emphasis added]" (p. 212). To mediate between the two is to recognize both function and scale—in human terms.

McDonald stated in an interview for this dissertation that "parking structures are a modern and misunderstood building form in need of reimaging and reinvention", (McDonald, 2019). Architecturally speaking, a parking garage is a node, or a place where at least two paths of movement intersect (McDonald, 2007, p. 185). "Movement" here is not an abstraction of traffic patterns, but of human activity. "The parking garage is a civic building type: needed by all, used by all, it is not a transient phenomenon but a permanent feature of every American life, and as such has the potential to contribute to the quality of that life" (p. 271).

McDonald (2007) echoes Lynch (1960), who noted in *Image of the City* that certain points or "nodes in the city are more important than others" (p. 185). These points, or zones, arise out of traditional street patterns, topographic changes, or at points of transit convergence. When identified, these important locations in the city become opportunities for urban and architectural expression.

McDonald (2007) argued that, as an element of daily experience, parking can act as an integrator, or as a point of "interaction and transition from one mode of movement to another". Viewing this transition as a unique and special experience that adds to the cultural cachet, rather than detracting from it, McDonald names parking as a feature of contemporary living that is vital and that is here to stay.

Calatrava concurs with this sentiment, speaking in the context of the Milwaukee Art Museum garage and suggesting that the parking lot is the place where 90% of the people arrive today; "he felt the entire Quadracci Pavilion [Milwaukee Arts Museum addition] should be an experience, starting with where you park" (Calatrava. 2001).

Of the possibility that parking structures could play a larger role in the human experience, McDonald (2007) predicted, "The decades to come offer a tremendous opportunity to affirm the vital civic role of this building type, to fully integrate the 'inside' and 'outside' experiences of the user, and to place the garage firmly within the tradition of architectural beauty" (p. 213).

According to Henley (2007), should private vehicle ownership and use continue to decrease, adapting existing parking structures to new uses becomes increasingly important. This has implications not only for the future of these structures, but for the

physical form of those buildings being planned today. If, for instance, the expectation is that these structures have the potential to be transformed in the future, then flat-plate structures without ramped floors—unlike continuous ramped floor plates—have an immediate potential for reuse. Other important accommodations are addressed in the Findings chapter to this dissertation. The trends and transitions contributing to changing expectations for parking as a building form—and for its possible future uses —are the subject of the second park of this Literature Review.

Historic traditions and perspectives

Modernism versus contextualism

The task of implementing a parking structure that is in alignment with zoning, legislation, and other mandates falls to professionals: urban designers, planners, architects, and landscape architects. These professionals have different understandings of how to design and develop a successful city, redevelopment, or parking structure. The underlying differences in the points of view of urban design and architecture have been partially responsible for the range of forms that structured parking has taken over the past decades.

Urban designers traditionally see buildings and other constructions—including parking structures—as an element in a streetscape that enhances the public realm or street space. They perceive constructions as architectural elements that exist in service of the larger urban setting or fabric. Architects view these structures as objects of the private realm, possessing their own ethos and spirit. Both ideas run through this dissertation's view of parking and its deployment as an element in the city

space, and each point of view can be responsible for radically different outcomes. Parking structures may celebrate their sculptural and constructed qualities, or they may take a secondary role, hidden behind simulated façades, wrappings, or overlays which hide their otherwise distinctive geometric forms and architectural expression.

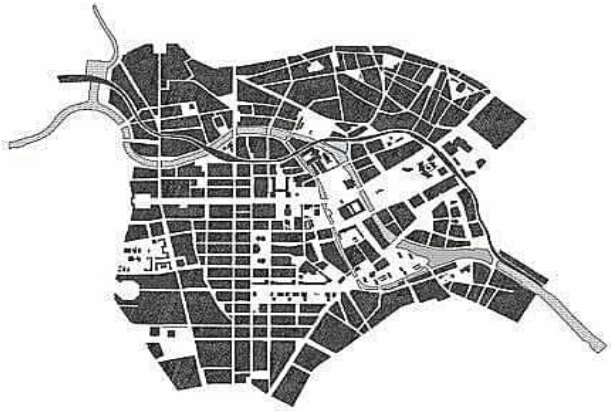


Figure 2.12. Figure-ground mapping exercise of urban space (Rowe and Koetter, 1975).

This dichotomy is illustrated in the use of figure-ground mapping exercises of urban spaces. The positive image of buildings and their footprints in a street setting represents the objective view, while the negative image presents its counterpoint (see Figure 2.12) — the negative space is defined by the outside edges and faces of the built forms and is essential in understanding the shape, orientation and hierarchy of elements in the public realm or street space .

In *Collage City,* Rowe and Koetter (1975) expands on the point and qualifies the character of each approach: “There is an abstract would-be scientific idealism and a concrete, would-be populist empiricism in each approach… an attitude of mind, which, for whatever it might profess, can scarcely deal with specifics *(modernism)*, and one discovers another *(contextualism)* which, despite what it might need, is radically

disinclined to cope with generalities" (p. 98). These authors describe the conflict between another set of binaries, modernism versus contextualism, which, like rationalism versus relativism, was a much-debated subject in that era as it remains today. Their argument contends that each point of view emerges from a different epistemological origin, and so are impossible to reconcile. Venturi (1965) expresses a similar point in *Complexity and Contradiction in Architecture*. In this text, Venturi decries the simplistic and singular program statements of modernism, "the complex program, which is a process, continually changing and growing in time yet at each stage at some level related to a whole, and should be recognized as essential at the scale of city planning" (Venturi, 1965, p. 88). Venturi also posits that "people understand buildings not as isolated and self-referential works of art, but in context, as parts of environmental milieus and historical traditions" (Faust, 2008, p. 43).

In the context of curating a 1988 Museum of Modern Art exhibit on deconstruction, Philip Johnson (Wigley & Johnson, 1988) counters that "contextualism has been used as an excuse for mediocrity, for a dumb servility to the familiar… by way of contrast, we argue, that avant-garde architecture is critically distant from any authority claimed by the context of an architectural object" (p. 1). For Johnson, the agency of architects and designers supersedes any demands that "contextual" mandates might impose upon them. Johnson had previously deserted his career-long allegiance to modernism in favor of popularity and celebrity, thereby ushering in a trend towards "starchitects," post modernism, vanity towers, and other architectural statements.

As the anthology of parking above suggested, these approaches also impact the world of parking design. These ranging perspectives are ultimately codified within public regulations in the form of zoning rules and design guidelines impacting, among other things, implementation strategies for building types such as parking.

These points of view also beg the larger question: How should the essence of what constitutes a city be defined? In *The City in History,* Mumford (1960) states that "language and communication are essential elements of civilization...the city...is in fact the great invention of society"(p. 5). To Mumford, intercommunication and networking are what make cities function and what allows for the interchange of the social and market forces which spawned the city structure from its infancy. Transportation and other networks of communication and commerce are all vital to the economy and the dynamic of the urban system. In Mumford's view, that urban system is a function of human activity—not vice versa.

Kevin Lynch's view aligns with Mumford's sharing the notion that the dynamic of urban spaces is based on connections. In *Image of the City* (Lynch, 1960) laments the lack of understanding of "the city image as a total field... the interrelation of elements, patterns and sequence." In his view, "it is extremely important to find ways of understanding and manipulating wholes, or at least of handling the problems of sequence and unfolding patterns" (p. 158).

For Lynch, all elements in the city space are a part of a composed whole and of an "unfolding pattern", and none of them—including the parking structure—can be relegated to some back bench or secondary level of consideration if our concern is the

overall composition and harmony of that whole. Lynch's term "wayfinding" is borne of this same sensitivity to that overall composition; it is a means for understanding how people—on foot, on transit, in private vehicles—navigate this hierarchy of objects and structures.

Hedman (1985), author of *Fundamentals of Urban Design*, touches on the challenge of hierarchy, explaining, "Contextual design is rarely a matter of absolutes. In most situations, the choice can be made from an array of options" (p. 13). Despite this "array of options," urban planning and architecture standards are each driven by perspectives—as above—that separate and prioritize. This binary view establishes one thing as more important than another, or subservient to it: streets and structures, vehicles and pedestrians, public and private, interior or exterior, cityscape or human scale.

It is not the binaries themselves necessarily that are the problem. Rather, the task is to be clear in the service of what, exactly, these binaries are being posited. Charles Moore, the former dean at the University of California at Berkeley and the Yale Schools of Architecture, describes an interesting possibility in his discussion of the four kinds of scale: scale as related to the whole, as related to other parts, usual or expected, and human scale. In his book *Dimensions: Space, Shape and Scale in Architecture,* Moore & Allen (1976) states that "the ways that scale can be combined are legion...[depending on] *what relationship you care to call attention to* [emphasis added]" (p. 17).

In an overall sense, zoning and design controls that define the rules for city building do not exist simply to create relationships between things. Instead, they

express collective cultural understandings—particularly of public versus individual (i.e., private) zones and precincts in the city. The façade of structures plays a dual role in defining this separation: it is the limit of the street or public space and the beginning of the private realm, the precinct of the individual and family. Giedion (1982) defined the separation of interior and exterior as the essential element of architecture—along with the sense of a third and broader element—the "cosmos or ecologic dimension" (p. i-iv).

This is perhaps one of the underlying reasons why urban planners and designers allocate extra attention to the street wall and any disruption or negation of its fundamental role. To paraphrase Moore, street wall-to-street is "the relationship they seek to draw attention to" (Moore and Allen, 1976, p. 24). Parking lots and parking structures, as they are traditionally sited and implemented, negate this fundamental relationship of the street wall. A hollowed interior, devoid of human activity, lends a blank slate to the otherwise active street zone before it. Likewise, the impetus to require active ground floor street fronts in these structures, as now required in many local zoning codes, only goes so far.

While classicists regard the façade as a formal statement of entry, identity, and connection, the approaches of modernism through post-modernism play with this distinction by treating the façade as a screen or veil between these two entities. De-constructivism goes further by defining this element as a thin and porous membrane or skin that can be manipulated and disguised.

Urbanism is heavily focused at the street as the primary domain in the urban form. Barnett (1995) states that the street "has always been the critical element in the

suburban public and open space system" , and goes on to say that, "if the automobile is an obstacle to creating urbanity in cities, then it is even more of a problem in the suburbs where people are almost completely car-dependent"(p. 215).

The Death and Life of American Cities (Jane Jacobs, 1956) did not describe the automobile itself as the obstacle; in contrast, "the destructive effects of automobiles are much less a cause than a symptom of our incompetence at city building" (p. 10). According to Jacobs, cities have far greater concerns to address. "How can you know what to try with traffic until you know how the city itself works?" (p. 11).

Giedion (1982) cited Haussman's efforts in Paris, a precursor to the City Beautiful movement in the United States of the late 19th century, in explaining that this was a period in which all new building was dominated by the street. In this author's words, "Two units of scale dominated, the promeneur versus the vehicle" (p. 770). This illustrates that the competition for dominance between building architecture and the street space preceded the automobile.

A non-binary approach would be to integrate these elements into a larger goal—or a larger "whole," in Lynch's terms; combining active and engaging public and private uses that truly expand and address the tradition of the exterior/public zone to the interior or private zone. By integrating public uses, a parking structure can extend the public domain. It can itself become, or become a part of, a place of connection where modes of travel intersect, or as a public forum in the ancient tradition of the Greek agora. Creation of a larger place of intersection and integration—to paraphrase Lynch—could be affected by focusing on the relationship between structured parking and the

greater whole of which it is a key element. An examination of New Urbanism shows the challenges trying to legislate or codify such relationships into being.

There are cultural implications in the positioning of buildings with respect to the public space of the street. These concepts are intertwined with our conception of the appropriate limits in terms of relationships between the public body and the inner and private precincts. The placement of the front façade of a building and its central mass helps to define these limits. In the following illustration, the options are depicted in their generic form.

Building mass or principal element orientation		**Façade placement and entry**	
1	Above the street level	4	Removed or remote from the street line
2	At the street level	5	At the street line
3	Below the street level	6	Within a prescribed setback to the street line

These choices can define a cultural sense of the appropriate placement of the individual with respect to the public street or the private interior zone, as well as that of an architectural tradition and urban design tenet.

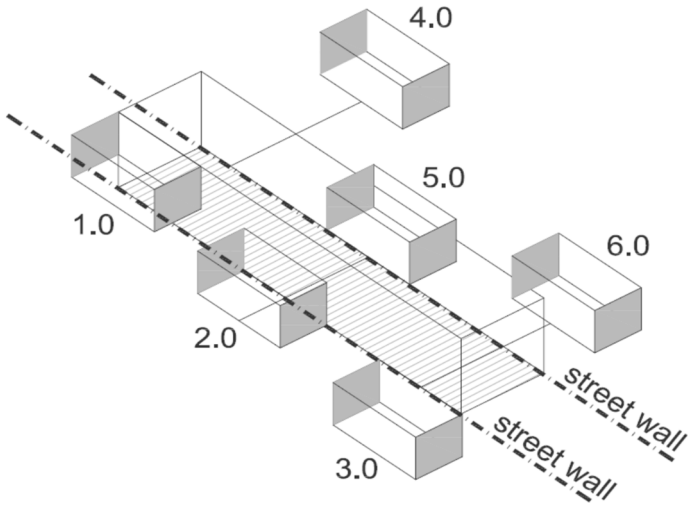


Figure 2.13. Characteristic building locations and the placement of the front façade with respect to the public street space (see Figure 2.14). This chart is an original diagram for this dissertation literature review.

These characteristics invoke an architectural and urban design style/tradition or dispostion, and may be mapped accordingly. Structured parking, like any element of the street or city space, must adhere to these same basic definitions in order to occupy a relevant place in that context. These concepts are directly related to issues of placement, scale, and massing in urban and suburan settings, and form the basis for contextual and cultural integration from an architectural and urban design point of view.

Key to streetscape diagram above:

	Building mass	Principal façade location/ orientation
Classist / Traditionalist	**2. At street elevation**	**5., 6. At streetwall or a designated setback**
	(Facades are symmetrical and emphasize entry, solid and opaque surfaces are modulated)	
Modernist / Rationalist	**1. Above street elevation**	**3. Remote from streetwall**
	(Buildings on plinths, ground plain undisturbed and reserved for public use, transparency from the interior to the exterior zone featured)	
Post modernist / Relativist	**2. At street level**	**4., 5., 6. Manipulated in all planes**
	(Façades evoke an independent element, or are treated as signage; scale is manipulated, especially with respect to the incorporation of traditional artifacts)	
New Urbanist / Contextualist	**2. At street level**	**5., 6. At streetwall or a designated setback**
	(Façades convey points of entry, and are traditional renditions of historic forms)	
Deconstructivism / Relativist	**1., 2., 3. All locations incorporated**	**4., 5., 6. Manipulated in all planes**
	(Building forms and treatments manipulate all elements of structure, skin and façade in an attempt to convey a revealed and exploded sense of the tectonics of the structure, and its traditions and cultural meanings.	

Figure 2.14. Key to Figure 2.13.

New Urbanism and form-based codes

New Urbanism manifestos authored by Andres Duany, Elizabeth Plater-Zybeck, and Peter Calthrop (Katz, 1994) informed the development of the form-based codes that are a featured topic in most state and national planning association conferences, and which are being adopted across the country. Duany's transect systems were derived in part from the British Garden City movement founded in the late 19th century by Ebenezer Howard. This was an attempt to reestablish local densified and complete towns or hamlets in a traditional aesthetic. It was advanced as a means to expand British communities into the suburbs. Giedion (1982) explains that Howard's vision of "towns and gardens married" failed to materialize as intended in post-war Britain; rather, what emerged was "a conglomeration of small houses in gardens" (p. 784). The modern New Urbanist and anti-sprawl movements can be seen in part as a response to this failure to achieve the aims of the Garden City movement. (see Note 1 for this chapter)

The transect systems enable planners and designers to formulate what is now termed a "form-based code" approach to zoning. These codes go beyond simple use and district standards to articulate specific expectations in terms of building forms, setbacks, and material choices in townscape contexts. Buildings with activated street faces and cladding that evokes traditional and familiar historic facades is are an outgrowth of the recommendations contained in new urbanist codes.

The adoption of form-based codes represents a significant challenge for local municipalities due to their technical challenges and the range of proscriptive guidelines

and regulations that seek to control outcomes from both a planning and urban design perspective. The complexity of these codes is apparent at first reading. They require the expertise of trained architects and planners to create effective interpretations and solutions. A review of model codes provided by Placemakers.com and entitled *The Codes Study*, (Borys, Emily Talen and Lambert, 2019), reveals that while issues of scale, setback, massing, height, street-wall, and place are addressed, the codes fail to address the *parking structure* at any level of detail. The standards that are incorporated are rudimentary at best and fail to embrace the range of options available in this building type along with its impact on all of the issues outlined above (see Note 2 to this chapter).

Parking, however, is given significant attention in the form of design guidelines for surface parking. Perhaps because form-based codes address and favor neighborhood and small-scale retail clusters, the assumption is in place that parking for the most part will occur on-grade (Form Based Code Institute, 2019). The attention the codes give to controlling open-field parking in urban zones is directly reflected in its tendency to destroy a sense of continuity in street walls and pedestrian places.

Although form-based codes can encourage a small-town, low-density model that is no longer relevant to an increasingly urbanizing population, they have in very general terms raised public awareness of design and planning concerns. At the same time, New Urbanism has been denounced by the likes of Rem Koolhaas (Larice & McDonald, 2007, p.), for its adherence to strict standards and its impact on individual design initiatives. These standards are, in part, responsible for producing the kind of homogeneity that

make it difficult to tell whether a development is in South Carolina or in Southern California. In *The End(s) of Urban Design*, Michael Sorkin (2006), Director of City College's Graduate Program in Urban Design, noted New Urbanist approaches as part of the "dead end" the urban design profession is moving towards (p. 1).

As a tenet of urban design, placemaking is seen as an antidote to the industrialization and mass production of place that contributes to, among other things, homogeneity and a resulting artificiality and inauthenticity. Ellin and Kelbaugh addressed this in Larice and MacDonald's *The Urban Design Reader* (Larice and McDonald, 2007). These contributions include *Critical Regionalism: An Architecture of Place* (Kelbaugh, 2002) and *Postmodern Urbanism* (Ellin, 1996), which address this issue and the larger subject of urban placemaking, and sustainability. (Kelbaugh, 2002) explained, "Critical Regionalism first and foremost starts out with a love of place... It honors local climate, topography, vegetation, building materials, and building practices. It prefers local authenticity to sophisticated imitation" (p. 299).

The Project for Public Spaces, an organization founded by William H. Whyte to foster the development and promotion of engaging public spaces, published a 2015 article by Ethan Kent. In this article, entitled "A Thriving Future of Places: Placemaking as the New Urban Agenda" Kent addresses the "Future of Places" program, a 4-year joint effort with UN Habitat to engage public officials worldwide in issues regarding public places.

Kent (2015) states that "many disciplines, corporations, and movements are approaching global problems with innovations that relate only to their own independent

interests and solutions" (p. 1). The modern vision of a future city, Kent cites, is focused on enabling mobility, and "ignore[s] the qualities that great cities can produce access, sociability, use, comfort, and identity—the ingredients of place" (p. 1).

Like Kelbough (2002), Kent (2015) was concerned about the impacts of globalization and mass production on the sense of place. This statement also aligns with Greg Squire's sentiment that:

> "there is the idea of 'critical regionalism', the suggestion that architectural and design outcomes should reflect culture and place, not merely a faceless internationalism. It rejects Western hegemony over architectural aesthetics, Eurocentrism in design, and the abstract faceless values of functionalist aesthetics" (quoted in Kent, 2015, p. 2).

Kent aims to shift the focus to creating "great places", this not only means that transit and mobility are considered as part of a larger whole but focuses on "reducing the need for travel...[and] creating community destinations where people actually want to be" (p. 1).

Critical Regionalism and Landscape Urbanism emphasize the restoration of a sense of place. They are linked in a 'resistance' to the consolidating sameness brought about by globalization and are linked as well by their focus on the local landscape to help define a vernacular sense of place based on culture and the environmental qualities of a particular region or locality. Both Critical Regionalism and Landscape Urbanism perceive current efforts at place-making as inauthentic. Responding directly to the universalism borne of post-industrial globalization, these theories reject commoditized construction superimposed on spaces that already possess an authentic—although possibly ignored—ethos. This concern includes the sameness of

suburban places, as well as intensely urban places undergoing significant redevelopment programs.

In *Towards a Critical Regionalism, An Architecture of Resistance,* Kenneth Frampton (1983) stated the need to reverse the endemic rise of globalization, given that its "cultural homogenization and technological uniformity" leads to "the demise of place" (Kelbaugh, 2002, p. 297). Critical regionalism seeks to validate space as an inherent quality of place, inseparable from its particular origins, traditions, vernacular qualities—that is, something that cannot be bought.

Frampton sees contemporary civilization as having developed through "instrumental reason" where everything, including space, is treated as a "means to an end" (p. 1). Fredrick Jameson (1997), a critic of the cultural impacts of postmodernism and late-capitalism, explained, "The very concept and program of Critical Regionalism reflects its moment in history, and in particular expresses the pathos of a situation in which the possibility of a radical alternative to late capitalist technologies (in both architecture and urbanism alike) has decisively receded" (p. 1). Jameson contents that the ethos of Critical Regionalism had resonance in its time but has been swamped by the forces of capitalism and globalism.

In an article from the *Landscape Urbanism Reader,* Kelly (2006) explained the significance of Critical regionalism to Landscape Urbanism, stating, "Frampton, and his belief in landscape as an operative tool to resist the globalizing and homogenizing tendencies of built environments has provided a platform for the conceptual evolution of Landscape Urbanism" (p. 144).

Landscape Urbanism seeks to rebuild the city and reimagine urban environments by challenging the basic precepts of the urban design establishment. In Landscape Urbanist vision, the landscape itself—with its ecological qualities and attributes — becomes the "basic building block of city making" (Waldheim, 2002, p. 534). As cities globally are growing outward, not upward—horizontally, not vertically—architecture has become secondary. In the Landscape Urbanist view, attention must first be directed at fundamental systems that address environmental concerns, such as water quality, landscape, drainage, and other basic infrastructure.

With its focus on landscape, Landscape Urbanism is necessarily concerned with issues related to climate change: armaments to sea-level rise, as well as a list of imperatives that include reducing overall carbon footprints for cities and entire regions. Also included in this reimagined cityscape are issues surrounding private vehicle ownership, gas versus electric powered vehicles, and parking and transit, which are also addressed in this chapter.

Waldheim (2006) goes further and claims a larger stature for Landscape Urbanism as the true authority for the future of urban design. He states that "... landscape has supplanted architecture's role as the medium most capable of ordering contemporary urbanism" (p. 42). He also attributes this position to two prominent architects of that era when he states that "Despite their divergent cultural politics... ...Rem Koolhaas and Ken Frampton had come to occupy curiously convergent positions but have concurred on this point..."(p. 42).

What, one might ask, is Landscape Urbanism's position on parking? Urban design as practiced, according to Waldheim, is elitist, regressive, consumption focused, and driven to recreate and reimagine zones of exclusion even in the densified city. New Urbanism as an extension of traditional urban design practice and to the extent it creates isolated privatized middle- and upper-middle class enclaves, it is as well opposed to Landscape Urbanism which sees itself as basically egalitarian in nature.

James Corner (2006), in his entry for Charles Waldheim's, *Landscape Urbanism*, confirms this position when he quotes the cultural geographer David Henry, "...comparing the formal determinism of modernist urban planning and the more recent rise of neo-traditional "New Urbanism,"... ... "both projects fail because of their presumption that spatial order can control history and process"... and that each is ..."imposed by uncontrolled capital accumulation, backed by class privilege and gross inequalities of political-economic power" (Corner, 2006, p. 28). On this basis, it follows that any investment that extends such values is opposed to the basic ethos of Landscape Urbanism, which like Critical Regionalism, sees itself as a force of resistance to urban design's globalist and consumer focused agenda.

Liberalization and justice are also dominant themes in the Landscape Urbanism ethos. To the extent that mobility is consigned to the elites, i.e. privatized vehicles, as opposed to a system of transit that embraces the total population, parking and its accommodations naturally oppose Landscape Urbanism inventions. On the other hand, to the extent that mobility embraces the later, and reduces dependence on privately-owned vehicles, it aligns with Landscape Urbanism goals. Transit and/or shared vehicle-

based systems that accommodate the populous and provide meaningful and economic access to movement and travel, and such systems may be considered aligned with Landscape Urbanist goals.

Adaptive reuse

The application of architecture to the adaptation, transformation, and reinvention of existing structures to new and varied uses is a current phenomenon with wide-spread significance. It is no less than the combining (and embracing) of the in-place, time-worn, authentic qualities of urban buildings and artifacts (Kelbaugh, 2002, p.248), with the creative insight to envision new purposes and uses for these forms. With a focus on sustainability, this movement for the recapture and reinvention of urban places prefers the adaptation of existing structures to the wholesale demolition and reconstructions of neighborhoods, zones and structures.

While adaptive reuse may claim a narrower mandate then Landscape Urbanism and Critical Regionalism, it is still an important component of the whole, while its definition may be consigned to individual reinventions and adaptations of buildings and infrastructure. *ArchDaily* published a list of 20 Adaptive Reuse Projects in Europe in March of 2016 citing a series of building and site adaptations of worth. (Santos, 2016, p. 1). All these projects have Landscape Urbanism overtones, though they are executed at a variety of scales.

That same publication went on to publish a list of significant projects that in its words, represented *12 Projects that Explain Landscape Urbanism and How It's Changing the Face of Cities*, the High Line in New York City was ranked at the top of these 12

projects that epitomize Landscape Urbanism (Gintoff, 2016, p. 1). Of this re-adaption and reuse of a former commercial freight railroad trellis system, author Vladimir Gintolf (2016) stated, “After decades in disuse, the [railroad] tracks had become a self-seeded park that the design by Field Operations, DS+R and Piet Oudolf sought to honor in spirit, but also augment with amenities like paved paths, benches, lawn spaces, and gardens” (p. 1). The significant, positive, and symbiotic association of Critical Regionalism and Landscape Urbanism points to, among other things, the fact that improving redevelopment outcomes is not dependent on the implementation of entirely new structures. This dissertation examines this issue in the context of the adaptation and the ultimate redeployment of parking structures in the face of decreasing demand.

The distinction between Landscape Urbanism and Adaptive Reuse may constitute a metric of scale, but otherwise, the sensitivities are aligned with the hope of a more resilient future when undertaken with the spirit of sustainable and responsible urbanist principals.

Summary

The origin and content of all recommendations contained in this dissertation are based on comprehensive and wide-ranging research and integrates all of the various approaches and details of planning and construction alluded to in the narrative above while enlarging an appreciation for the applicability of the five criteria: sizing, scale, massing, visual, and placement. Recasting the literature on this basis provides a framework that unites all of these various sources in a succinct and organized way and

adds clarity and applicability to these concepts drawn from architecture, urban design, and planning theories.

In the following Methods chapter, the qualities of these structures and their applications to the framework of the five elected criteria are explained. The ultimate outcomes of this research effort integrate traditional urban design standards into the strategies and guidelines depicted in the Findings chapter as well (these strategies and guidelines and their depictions are presented in more detail in Appendices C and D).

NOTES FOR LITERATURE REVIEW

Note 1: English Garden City movement, American suburbs, and New Urbanism

Several sources have confirmed the origins of New Urbanist doctrine and its relationship to the English Garden City movement of the late 19th century. William Fulton, editor of the California Planning and Development Report and a board member of the Lincoln Institute of Land Use, in his 1997 text, *New Urbanism: Hope or Hype for American Communities*, described New Urbanism and its origins:

> "In their purest form, all the earlier approaches... *to townscape redevelopment post war*....fell by the wayside in the rush of postwar American suburbanization. In bastardized form; however, the Garden City approach came to dominate suburban planning during this period. Though derided by Mumford and other Garden City leaders, the typical postwar suburb actually was an auto-dominated derivation of their idea, complete with the neighborhood unit that insulated the interior residential streets from through traffic speeding along arterial routes lined with strip malls". (Fulton, 1997, p. 9)

This article included an overview of Lincoln Institute's, December 1995 sponsored seminar, "*The Influences of New Urbanism: Design, Development and Behavior.*" Attendees included Douglas Kelbaugh and others, Fulton (1997) explained,

> "The garden city model was also better adapted to subdivisions of ranch houses, "capes" and other small housing styles than were the more urban, formal towns and villages designed…from the 1920s through the 1980s, virtually all American "new towns" were modeled on these forms"(p. 9)

Note 2: Form-based codes and standards for structured parking

A need for an enlarged focus on structured parking

The lack of attention to structured parking in zoning codes has been noted. Surprisingly, even form-based codes have lacked this focus. Several sources further confirm a lack of attention to structured parking as a building topology requiring attention and reform. New Urbanism as an institutionalized idea and approach to zoning is given shape in form-based codes such as those promoted by the Form Based Code Institute (2019), a division of Smart Growth America. As stated previously in this dissertation, however, even with the recognized importance of structured parking to Smart Growth, transit-oriented development districts and commercial districts in new urbanist communities, little attention is ultimately paid to parking structures.

Planners Web's overview of New Urbanist codes by Mary Madden and Joe Russell made a singular reference to parking structures in their *Review of Form Based Codes, Part 3: Typical elements of form-based codes*:

> Parking—Form based codes generally require parking to be on-street, behind buildings, or in parking structures that have "liner" units or buildings at street level. Parking lots that front on a street are generally not permitted, and where they are allowed, they must be screened to maintain the street wall. The aim of all this is to activate street life—by having retail or related uses line streets and sidewalks, not parking lots (Madden and Russell, 2014, p. 1).

Madden and Russell defined liner buildings as:

> A building that is placed between a sidewalk and a parking structure to screen the parking structure and maintain an active street frontage instead of the dead space typically found next to a parking garage. Sometimes the front portion of the parking structure itself is designed to accommodate built-in storefronts or residential units which are referred to as "liner units" (p. 1).

Emily Talen has collaborated with Duany and others in the New Urbanist movement in the past. She oversees a comprehensive catalogue of form-based codes at *The Codes Study* website published by Placemakers. This author noted that "though form-based codes are 38 years old, 91% were adopted since 2001" (Borys, Talen & Lambert, 2019, p. 1).

The *Yonkers NY Downtown Code*, adopted relatively recently in 2011, stipulates only four basic requirements for parking structures, all addressing facade treatment only (Yonkers, 2011, p. 51):

1. *The design of the facade that fronts on a public street shall include horizontal design elements, such as knee walls and cornices, which reflect the design of other structures in the downtown districts.*
2. *On portions of the ground floor façade where parking spaces are visible, a decorative screen shall be required above the knee wall to screen traffic and pedestrians in the public right-of-way from headlight glare. The total height of the knee wall plus the decorative screen must be a minimum of four (4) feet.*
3. *A parking structure accessory to a principal building shall be constructed with materials and design elements that reflect the principal building.*
4. *For parking structures with rooftop open-air parking, a parapet wall of four (4) feet shall be required. Additional screening of rooftop open-air parking is encouraged in addition to the parapet wall.*

This represents a very limited list of standards for a major metropolitan city with significant density.

Yorkville, IL, a community outside of Aurora, IL has adopted a downtown overlay ordinance that begins to deal with some of the issue's primary to this dissertation effort

by taking the “liner building” route advocated by the Form Based Code Institute.

Limitations on the location of parking and access within building types vary by street type, as noted in these excerpts from the Yorkville, Il. zoning ordinance (Yorkville, 2018).

f Parking & Loading Location	Rear yard [3]	
Entry for Parking within Building	Rear & Side Facades	
g Vehicular Access	Alley	Alley; if no alley exists, 1 driveway is permitted per street frontage
h Parking & Loading Location	Rear yard; attached garages access off rear facade only. [4,5]	
Entry for Parking within Building	Not Permitted on Primary Street	
i Vehicular Access	Alley; if no alley exists, 1 driveway permitted off non-Primary street; if no side street, 1 driveway permitted off Primary Street; shared access is encouraged.	

In addition, Yorkville addresses issues such as curb cuts and vehicle access which are addressed by district and street type. Standards for freestanding parking structures exist, but in elementary form (p. 21).

> (c) Parking Structure. A parking structure on a lot that does not contain a permitted Building Type and is solely used for the parking of vehicles. In the districts where a parking lot requires a special use permit (“0”), the following applies:
>
> *i. Corner Lots. A corner lot shall not be used for a parking structure.*
> *ii. Adjacent Parking Lots. Two (2) parking facilities (lots or structures) cannot be located directly adjacent to one another.*
> *iii. Primary Street. No facade of the Parking Structure shall be located on a Primary Street. Refer to Figure 10-21-2G (4). For Parking Structures located on a Primary Street, the Main Street Building Type shall be utilized, requiring occupation of the building in the front thirty (30) feet of the facade on any Primary Street.*
> *iv. Distance. Parking lot must be within 1,300 feet of the principal entrance to the associated use unless:*
> - *At least seventy five percent (75%) of the spaces are dedicated for public use.*
> - *An approved parking agreement is in place (refer to Section 10-16).*

- *It is connected to associated use by a dedicated, public pedestrian way.*
- *Parking structures for commercial vehicles are not permitted in these districts.*

Yorkville's ordinance begins to take a step towards more stringent and broader based standards for structured parking. These standards need to emerge and begin to be codified in ordinances such as these and this is one important outcome of this research effort.

Note 3: Panel acceptance of urban design and planning standards

Putting aside the issue of visual presentation, it will be illustrated in the Findings chapter that the panel members endorsed every other element for the physical design of these structures as outlined above and as drawn from the literature of architectural and urban design theory. To the extent that individual models, prototypes and simulations incorporate those approaches, they were endorsed and ultimately scored well in the simulations in which they were incorporated.

CHAPTER 3. METHODS

Introduction

As demonstrated in the literature review, parking as a designed structure is not consistently accorded the same status or consideration as other structures in a redevelopment zone. This dissertation intends to demonstrate that by focusing on five key properties (i.e., size, scale, massing, visual, and placement), the design, character, function, relevance, and the overall effectiveness of structured parking can be dramatically improved.

These five key criteria, rooted in urban design and architectural theory, are central to the first research question and were conceptualized in consultation with dissertation committee members. They represent clear, distinguishable qualities, not only of parking structures, but of all built structures, irrespective of function. As criteria, they are recognizable, understandable, and universal to all stakeholders. This is especially important, given that the development of structured parking is impacted by the perspectives and concerns of stakeholders and entities in the public, private, and institutional spheres, and ultimately experienced by lay users of all ages and backgrounds.

To assess the above, and to explore the second research question regarding the impact of social, demographic, and social trends on vehicle ownership, usage, and parking demand, the current study employs four primary methods:

1. Census-based investigations of automobile ownership patterns, reviews of public regulations, and group and individual surveys to understand both current and potential future demand for parking;
2. Focus group panels (comprised of lay, professional, and public sector participants) to explore and quantitatively evaluate (using a Visual Preference Survey™), issues of sizing, scale, massing, visual representation, and placement. These panels focus on six generic prototypes of parking structures that were all developed from an iterative design exercise to represent standards and design conventions from traditional urban design and city-building literature;
3. A set of detailed pro formas to predict parking costs, rents, and returns, offer insight into the economic and decision-making factors of the redevelopment process. Based on land values, parking ratios, development and square foot yields, the pro formas also address related issues, including choices in façade, the implications of including ground-floor retail or office use, and increasing capacity to eliminate street parking;
4. Interviews with public and professional subject matter experts in the fields of planning, engineering, parking management, redevelopment and zoning policy, development, and transit, all of which are involved in land-use—specifically parking and its adaptation in a redevelopment setting.

Selecting, developing, and refining these methods facilitates the generation of data and insights otherwise largely unavailable in the literature concerning structured

parking as an element in redevelopment. Through the lens of the five key areas of inquiry, it is possible to generate insights on parking as a unique and particular type of structure.

Broader implications for research methods

Expanding the scope of the VPS™ technique

This study expanded the existing VPS™ technique in its use of relatively abstract criteria to evaluate design options. Panel members' ability to understand and differentiate complex, conceptual, and intellectually challenging evaluation criteria was tested and analyzed across all panels and for individual criteria.

Historic urban design and planning conventions tested and validated

Those same criteria form an important subtext to this dissertation. These criteria are the basis for a series of design standards and city building practices that are present not only in the literature, but in centuries-old design and planning conventions. These conventions are the basis of developing the iterated prototype models used in this dissertation; as such, these parameters undergo a rigorous series of examinations in the simulations provided.

These criteria are tested in multiple forms throughout this research effort, from specific development and redevelopment site simulations, to responses to direct questions that emphasize these points of interest and concern. When viewed comparatively, the results lend direct evidence to the ultimate value of these conventions, and their relevance to the process of urban design and planning for these structures. It was anticipated, based on similar studies conducted on architectural and

urban design examples, that focus group members would find these parameters and conventions both relevant and important, and that has proven to be the case.

Social science research versus design research

The research questions that guide this dissertation are interdisciplinary by nature, and aim to address the design, implementation, character, and overall effectiveness of structured parking. The question also considers whether ongoing institutional, technological, cultural, and demographic changes can be incorporated into the parking structure's development process. Given these goals, it is important to address differences in social science research versus design research. As previous scholars have discovered, synthesizing the two approaches can expand the applicability of case studies.

Case study usage in the social sciences often entails the observation and examination of subjects and events in order to identify how they are similar and different. Cases can be selected randomly, or intentionally structured as a series of stratified examples selected for their generic and contrasting content.

Case study research is typically associated with a temporal restraint. By nature, the events depicted and the evidence collected are focused on past or existing conditions to describe a set of circumstances or subjects of interest. The missing element is the future condition, or a projection of a future condition. The prototype models developed for this research effort are based on past guidelines, but also look toward the future to parking's potential as a building type, and to its possible ultimate implementations and applications.

In *Architectural Research Methods,* Groat and Wang (2013) explored the differences between research methods normally employed in the social sciences and those utilized in architectural design research. These authors argue that architectural research addresses a temporal and situational condition concerned with improvements to the form and utility of architectural or building prototypes, and not to the accumulation of specific and widely applicable systemic reforms. Accordingly, this dissertation uses observations of generic prototypes and site-specific case scenarios to explore the common threads of best practice methods.

Figure 3.1 cites the significant differences between case study-based research in the social sciences versus the design fields.

Chart: Mixed methods and the differences between architectural design research and general research in the social sciences

Facets of Differences	Design research	Social Research
Contribution	Proposed for Artifact (from small–scale to large-scale interventions)	Knowledge and/or application that is generalized (in diverse epistemological terms)
Dominant Process	Generative	Analytical and Systematic
Temporal Focus	Future	Past and/or Present
Impetus	Problem	Question

Figure 3.1. Social science research vs. design research (Groat & Wang, 2013).

Groat and Wang (2013) describe a design process based on the testing, analyzing, and refining of a product or process. These authors recognized that although design and social science research are both undertaken for contextually specific purposes, the “specific impetus” for each is different. Design is concerned with a “problem,” which these authors describe as “an unmet need for a new building or product (p. 584). Social science researchers, however, aim to answer a specific question.

Groat and Wang (2013) cite research protocols at the University of Michigan that address the definition and acceptance of "generalizable knowledge"(p. 598) to describe all research that is hypothesis-driven, quantitative, and/or replicable. More broadly, these authors referred to "research conducted in multiple epistemological frameworks, or systems of inquiry" (p. 645). This same framework was adopted in this dissertation in order to pursue outcomes from multiple points of inquiry.

Johansson (2003) states that cases in the area of architectural design should be viewed from an independent perspective. Referencing Groat and Wang's work, Johansson advances the notion that "cases in architecture are suitable for analysis under abductive theories of knowledge" (p. 2) and "that the boundaries …change through the course of the research phase" (p. 5). Johansson also discusses the issue of the "triangulation" of various research techniques in case study research, with an emphasis on "abductive reasoning" as one of several approaches to the analysis of cases (see Note 1 to this chapter).

Beyond Groat and Wang's work, other sources related to the research of architectural subjects include Ray Lucas of Manchester University (Lucas, 2015). Lucas' *Research Methods for Architects* is rooted in case analysis and "research methods appropriate to architectural humanities, developing the role of architecture as a discipline with an interest in the theory of spatial production, the social role of space, and the historical context within which we live" (p. 7).

Architectural subjects include physical, functional, social, cultural and visual/aesthetic considerations. As such, methods that engage multiple considerations

provide a unique and appropriate point of inquiry. In this dissertation, panel members were asked to evaluate functional, physical and visual/aesthetic attributes through the VPS™ session simulations by scoring of these exhibits according to the five stipulated criteria – directed at Research Question 1. Further, social and cultural issues were addressed by panel members' responses to direct survey questions pointing at changing demographic, mobility and settlement trends – directed at Research Question 2.

The Visual Preference Survey™

The inferred relationship between source and prototype can be quantified and ranked in the context of a Visual Preference Survey™. Capturing the similarities between source and prototype serves to define a successful execution of the building type in question, allowing for the creation of guidelines and strategies for future development.

Developed by Anton Nelessen, a member of this dissertation committee, the Visual Preference Survey™ provides the methodology for collecting and quantitatively assessing these very sorts of observations—that is, by way of comparison and knowledge by inference. Nelessen's success in the development and use of Visual Preference Surveys™ informs and guides the survey technique used in this dissertation's focus groups. Nelessen's work is a verifiable technique for appraising performance criteria—that is, the five key properties that served as this dissertation's focus.

In an article in the Planning Commissioners Journal in March 1993, Nelessen & Constantine described the use of the VPS™ in the development of master plans for communities in Metuchen, New Jersey, and Big Bend, Washington. In both cases, prior

to the development of plans, previews of paired images were tested to form a qualitative understanding of desired outcomes for the projects. Participants scored images on a 20-point scale (a -10 to +10 scale that is also used in the research effort for this dissertation). The results formed a basis of understanding, enabling the adoption of draft codes based on community articulated preferences (Nelessen and Constantine, 1993).

Nelessen's work includes *Visions for a New American Dream* (1993). In this work, Nelessen presented 10 basic design principles for small communities. Because the character and quality of the review forum is vital to successful outcomes, Nelessen advocated for the development of an outline draft of an "approval process and submission documents" (Nelessen, 1993, p. 349-363). This emphasis on process is echoed in the current dissertation.

VPS™ techniques have been integrated into research methods in the larger field of cognitive perceptual studies. These approaches are increasingly relevant in the world of design theory, where evidence-based design is applied to such areas as workplace environments, health care settings, and urban design and planning problems. (see note 2 for this chapter). VPS™ methods, as developed by Nelessen, are expanded in this dissertation to include model simulations of infill and transit development sites. These techniques are also advanced by asking focus group participants to rate subjects using a set of criteria which may be considered complex or even abstract in nature.

Straightforward statistical methods can assess the consistency and validity of such an approach. These include: *t*-tests for variances between and among groups and

panels, the testing of results on a pooled and individual panel basis of both summary results and ratings, and individual criteria scores. These analyses provides four levels of verification for these small sample panels: pooled, individual panels, pooled by criteria, and individual panels by criteria. This level of scrutiny is comprehensive and significant: by obtaining panel results by age cohort and by gender (an approach utilized in other research efforts of a similar nature), the potential biases of these external factors are isolated, if not eliminated (see Findings, Chapter 4, for details of this analysis).

The success of these methods permits them to be extended to other subject areas and other buildings types. For example, in urban design and planning, they can be used to assess building types and other components of the urban landscape, including parks, recreation, and public amenities.

Evidence-based design and multi-method research platforms

The research methods of this dissertation are informed by Evidence Based Design (EBD). This multi-method approach to evaluating design performance has emerged as a verifiable technique in health and education facilities design (Hamilton &Watkins, 2009). These authors define Evidence Based Design as "a process for the conscientious, explicit and judicious use of current best evidence for research and practice in making critical decisions, together with an informed client, about the design of each individual and unique project." (p. 4). The methods of this approach are extended in this dissertation to examine structured parking in its form and implementation in urban, suburban downtown, and exurban settings.

The unification of several research approaches produces multiple levels of qualitative and quantitative data, as well as other evidence for evaluating overall performance for this building type. Those methods include direct survey, VPS™ focus group evaluations, cost and economic performance ratings, and other inputs such as demographic inquiry and the direct appraisal of performance criteria—in this case, these criteria include usability and codified parking ratios.

Brandt, Chong and Martin (2010) outlined the range of methods and subject matters advanced through Evidence Based Design (EBD) techniques. These authors also reference writings from William Mitchell of the MIT Media Lab regarding the social sciences and a scientific basis for EBD. They note: "the process of design and evidence application requires iterative cycles of framing a challenge—a hypothesis—and measuring the performance outcomes from specific design intention and actions" (p. 11). These authors also note that "virtual models using simulation technologies are replacing some physical material models in the making of prototypes (p. 12), and that "the influence of physical models, prototyping, testing and simulation on architecture…is a process of thinking by doing through a set of iterations and is highly relevant to creating architecture" (p. 13). As this dissertation and research effort unfolds and is outlined in later chapters, the utility of this approach comes clearly into focus.

Prototype testing in the design process

Prototype testing is derived from engineering methodologies that focus on the development of models through iterations and reviews as well as evaluation and testing through panels or focus groups that include engineering experts. The testing of a

prototype or a developed design is considered an important part of the design and manufacturing process. Testing and evaluation confirm either that the product will work as intended, or that the product needs refinement.

The use of prototype models to explore design alternatives for parking structures serves as a basis for evaluation and consideration of new models and their implementation in the design and urban planning fields. The prototypes developed for this dissertation draw on both engineering and parking management best practices found in the literature. The models also embody urban design and architectural guidelines for street scale, placement, and presence in alignment with best practices for their generic types. Four different settings, which were selected in consultation with the dissertation committee, provide a succinct set of comparatives (see Note 3 to this chapter).

In addition to design and prototype development methodologies associated with product development and design, focus group research was conducted to gather insights and to evaluate physical attributes of similar cases in architectural design, planning, and urban design. The following figure depicts the cyclical and iterative nature of the design process and demonstrates the role that prototype testing can play in this sequence of work.

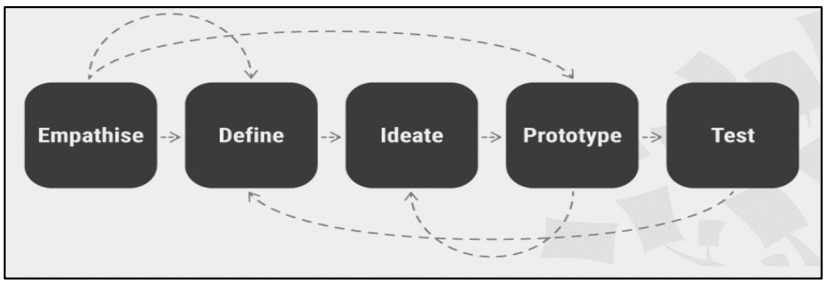


Figure 3.2. Iterative design process (Dam & Siang, 2019).

The interactive methods of design research provide a larger and more comprehensive view of a problem and have the potential to connect design solutions to a broader range of associated areas of interest. The trend towards integration of user experience in the design process also parallels the prototype and iterative methods employed in this research effort.

As Dam and Siang (2019) state, “in practice, the (design thinking) process is carried out in a more flexible and non-linear fashion. For example, different groups within the design team may conduct more than one stage concurrently, or the designers may collect information and prototypes during the entire project so as to enable them to bring their ideas to life and visualize the problem solutions” (p. 2). The diagram in Figure 3.2 suggests that the iterative process is ongoing and relies on continuous feedback throughout the prototyping process.

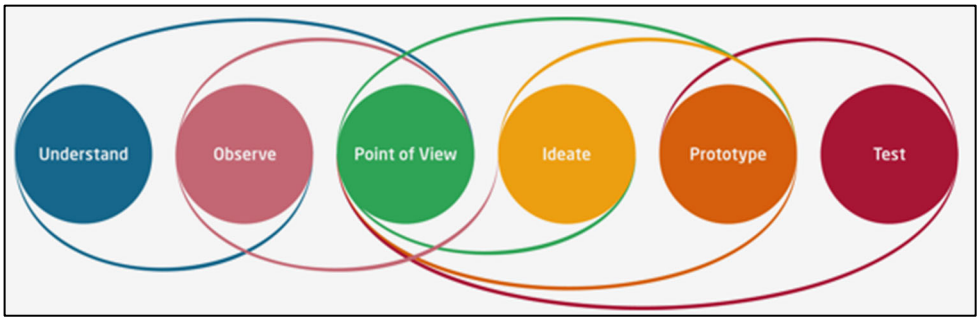


Figure 3.3. Design thinking process (Hasso Plattner Institute of Design, 2019).

As the diagram suggests, the rethinking of prototypes and models continues until the very end of the analysis, which results in new approaches to tested prototype models (see Figure 3.3). A new approach to underground garages and the use of parking infrastructure as an element in the arming of cities against global warming are

two outcomes derived from panel reviews, the assessment of results, and of the rethinking of the problem.

Iterative design sequence of prototypes and cases

In its initial stages, the creation of prototypes for the VPS™ panels begins with a basic iterative investigation into various forms of structured parking followed by the embedding of a range of generic parking approaches within graphic and virtual models (as seen in contemporary redevelopment programs).

Prototypes for parking structures were selected to represent the full range of forms typically found in development and redevelopment settings. These forms consist of two basic types: (a) single parking structures above or below grade; and (b) structured parking integrated into mixed-use buildings of office and residential uses. In the first case, the structures were primarily utilitarian and encased in various visual screens or facade treatments. In the second case, parking was integrated into the form of a larger and more complex building and was generally wrapped with or stacked into those other uses. These models are intended to be tested and refined based on a set of guidelines derived from the literature to advance best practice examples of six commonly encountered generic approaches.

Following the development of these generic prototypes, four contextual settings were selected in consultation with the dissertation committee. The first is a simulated downtown infill site that reflects broad-based common applications. This also aligned with dissertation committee chair Professor David Listokin's research in this area. Complementing and enlarging his findings, this model also offered physical proofs for

the strategies addressed therein. The simulated model was fashioned on a generic Midwestern city grid with an east-west railroad frontage street, with parallel major streets, and minor streets extending north-south away from the rail frontage. Oklahoma City, Oklahoma, Abilene, Kansas, Boise, Idaho, and many other midwestern cities conform to this basic city form. Long blocks run north-south with internal alleys, and the ends of these rectangular blocks turn to provide frontage on the major east-west streets.

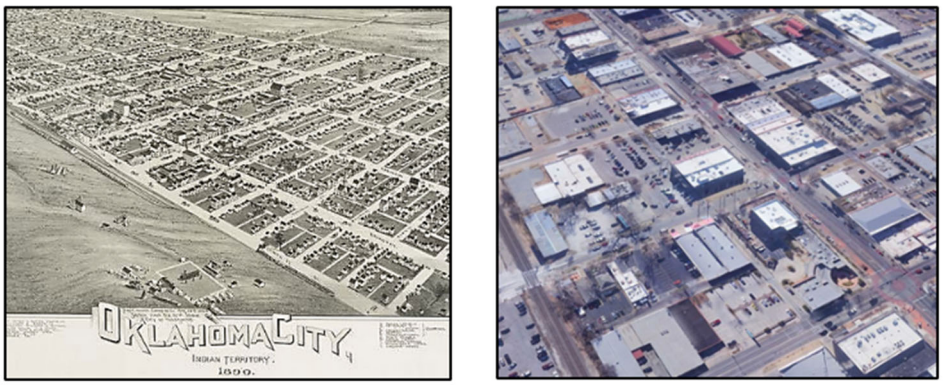


Figure 3.4. Typical streets and blocks, Oklahoma City - model for the infill simulation.

The remaining three cases were developed in consultation with dissertation committee member Professor Darius Sollohub, whose prior work in this area has included illustrating parking applications for transit-located development sites. The cases span the range from urban and regional transit sites to exurban redevelopment locations: (a) center-city transit station, (b) a suburban regional transit station, and (c) an exurban new town center at an intersection of two major interstates that represents a new urbanized cluster without direct transit access.

Setting the generic prototypes in three distinctly different transit-located development sites enlarges Professor Sollohub's work to include the quantified

evaluation of criteria for similar applications previously addressed in his studies. These scenarios offer a comprehensive range of redevelopment options for each case; incorporate various options for parking, access, and street presence; and present the potential for other uses in model redevelopment zones.

Spanning a range of options within the redevelopment context, the six prototypes (see Figure 3.5) enable the evaluation of the five key properties that are the focus of this dissertation: sizing, scale, massing, aesthetics and visual representation, and placement. These options also incorporate aspects of identified current trends associated with a future reduction of private vehicle usage, as well as streetscape and development standards for autonomous vehicle integration.

A series of typical parking decks were selected following the examination of models of structures described in Sollohub et al. (2007). The selected decks provided the basis for confirming overall efficiencies of layout. Juxtaposing these studies against typical street grids and urban redevelopment patterns allows for development of plate sizes and modules in a variety of consistent forms.

This portion of the research effort represents the central portion of the iterative design research process cited above: define, ideate, prototype, test, reimagine, and iterate again.

The work begins with multiple studies of small, single-lot infill options, proceeding to multiple-lot infill configurations, and finally to full-block infill applications. These studies, in turn, serve as the basis for creating prototypes in various sizes and capacities intended to provide comparative models that can be scored in the VPS™

sessions under the five evaluation criteria. Those prototypes are developed at a scale and dimension that can be integrated into downtown street grids, as well as into transit and non-transit development sites. These designs also enable the creation of standards for size, dimension, and configuration in a module that adapts to urban settings. The development of a series of alternate iterative examples of layout, capacity, and configuration leads to several adaptable models which, when integrated into both parking structures and mixed-use structured parking solutions, provides a best fit adaptation of parking to urban and suburban infill settings.

Urban design guidelines, including approaches referenced by Lynch (1960), Hedman (1985), Barnett (2003), Rowe & Koetter (1975), and Cullen (1961) are integrated into the prototypes to optimize results and represent best practice solutions. These guidelines include issues related to setback, street wall, base-heights, setback floors, sky planes, active ground floors, and a variety of massing, scale, placement, and visual treatments (see Note 4 for this chapter).

Iterative design studies for this dissertation

The first set of studies addresses platform designs in typical configurations shaped by restrictive zoning standards and parking ratios. This is followed by more flexible approaches, utilizing parking ratios that reflect reduced demand in downtown urban settings, where parking requirements for individual users and shared parking programs reduce actual built parking to approximately half of the current-state suburban residential site standards (see detailed analysis contained in Appendix G1-G6 for details of prototype sizing). Finally, a full-block examination is performed, and the

options examined in the first two series are translated into a full-block downtown infill requirement. Sensitive to parking demands, overall density is also examined. This includes building heights within a four-to-five story height limit and ground floor retail configurations that match market standards with a frontage of twenty to twenty-five feet and a depth of sixty to seventy-five feet. Following this first tier of analysis, options for placing moderately-sized freestanding parking structures within the typical full-block footprint found in most plat plans for urban and downtown suburban settings are examined.

The assumptions begin with the examination of a single block consisting of eighteen 25-foot by 125- foot typical lots on two frontages. The total block dimension translates to 250-feet x 450-feet, representing a typical urban commercial or residential block in a traditional eastern and midwestern American city, as Anderson (1978) depicted in *On Streets*. Combinations of double-bay and triple-bay parking deck circulation plans are also modeled for these typical blocks, referencing Sollohub et al. (2007). (See note 5 to this chapter).

These investigations proceed very much in the spirt of Hasso Plattner Institute's diagram, *Design thinking process,* as profiled in Figure 3.3.

To summarize the studies appearing in Figure 3.5A-F, the following description is provided:

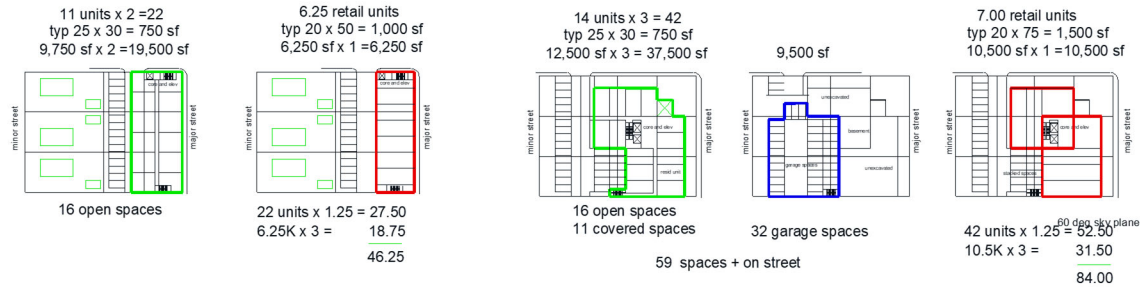
> The first investigation begins with the examination of mid-block infill options and options for corner lots under typical in-place zoning constraints (see Diagram A in Figure 3.5). In Diagram B, those options are extended to full block

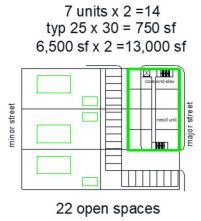
infill iterations and combined both surface, underground and podium approaches to structured parking. Diagram C demonstrates a comparative study for the same full infill block using standard parking deck dimensions, footprints and configurations.

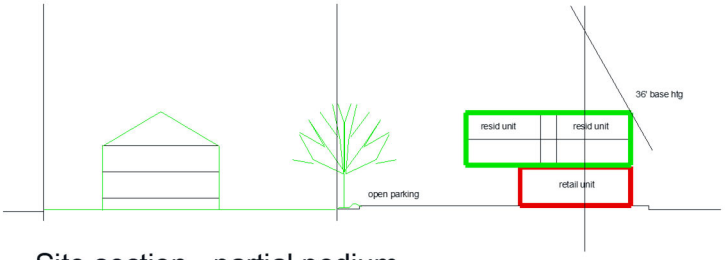
A more detailed examination of the three-dimensional form and circulation restraints of double- and triple-bay parking decks is examined in diagram D and E in Figure 3.5. Finally, Diagram F examines these single use parking decks for the implementation of mixed-use residential or office structures with internalized parking amenities.

These studies led directly to the prototype models depicted in Figure 3.6 and are the basis for the simulations of infill and case study sites used in the subsequent panel reviews conducted for this dissertation. This process of iterative design options is consistent with the techniques studied in the literature and provides an evolving understanding of this building typology, which is the root of this dissertation effort.

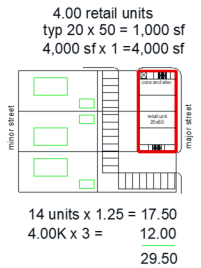
A. Platform infill structures on small lots:

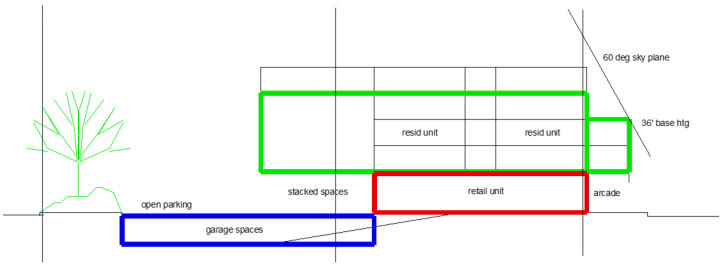






Site section - partial podium

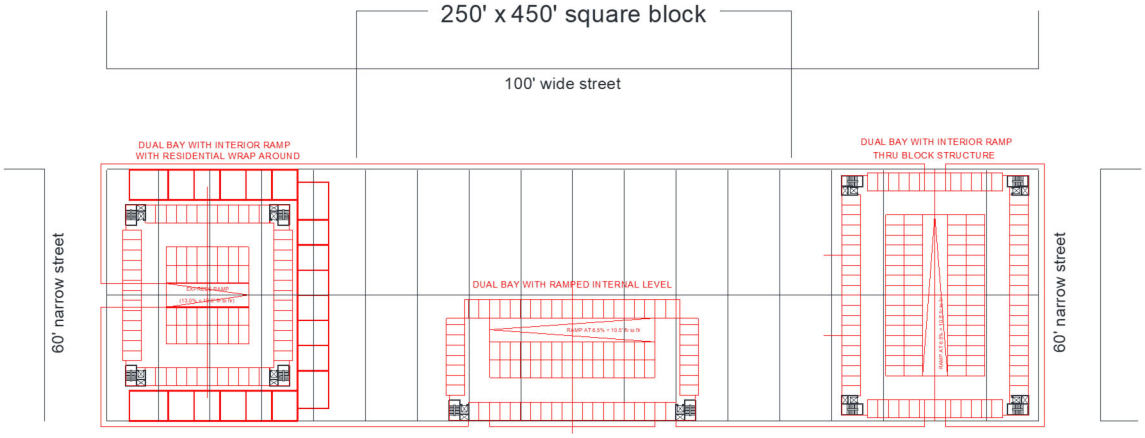




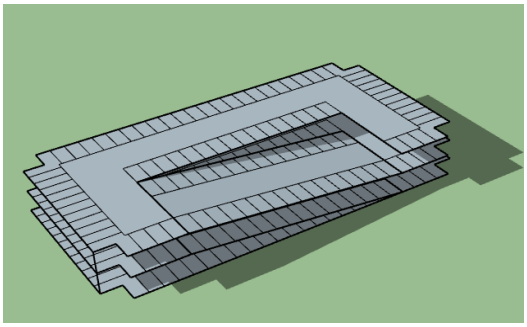
Site section - underground structure

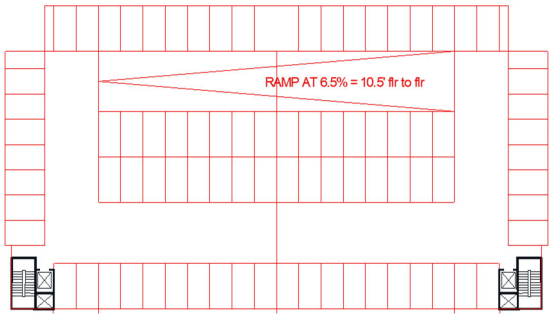
B. Full block infill with structured parking at rear yard:

C. Full block overlays of dual and triple bay structures to assess fit, access options and orientation:

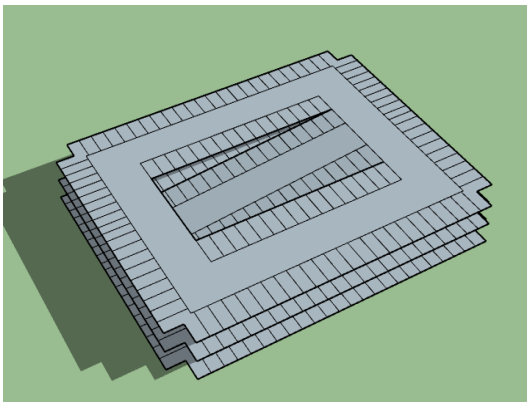


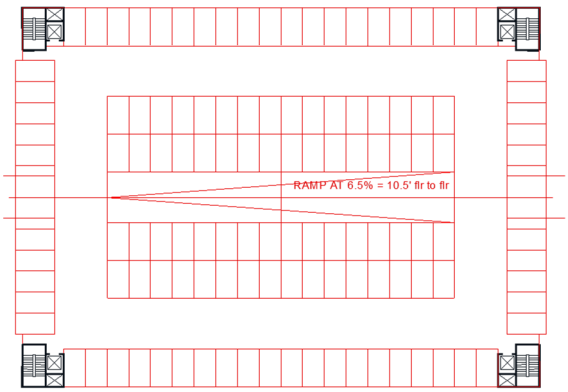
D. Option 1. Dual bay with a single ramp at each floor





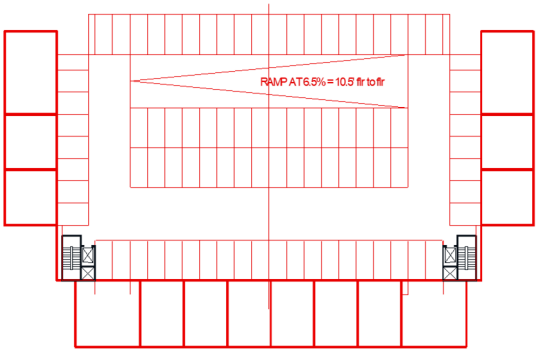
E. Option 2. Triple bay with a single internal speed or parked ramp



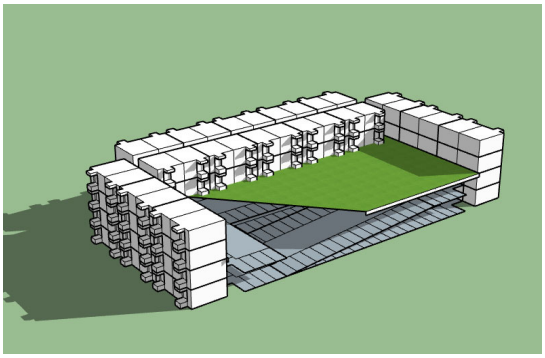


F. Options 3 and 4. Next level iteration for dual- and triple-bay structures with wraparound residential

Dual bay structure with parked ramp

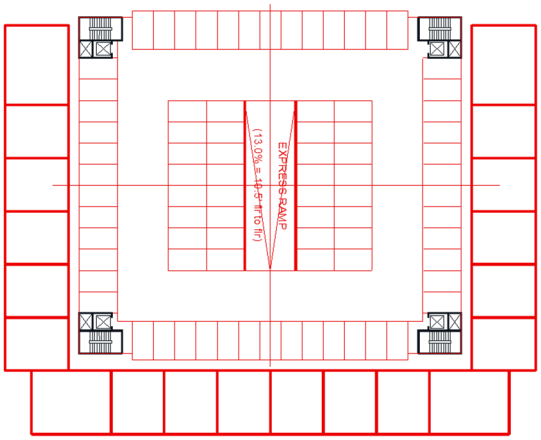


3D model – Dual bay garage

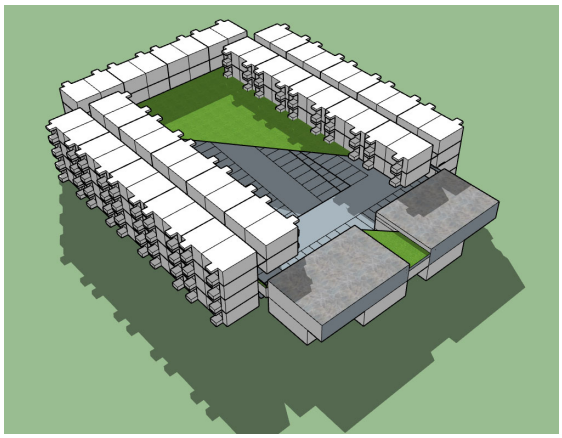


Dual-bay structure incorporating an external sloped parking ramp

Triple bay structure



3D model – Triple bay garage

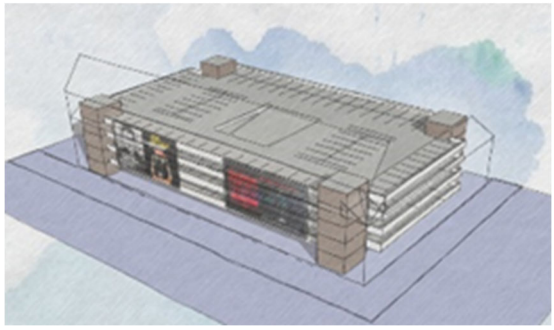


Triple-bay structure incorporating an internal speed ramp and tandem spaces

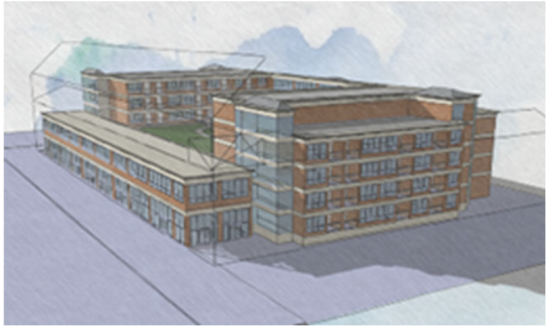
Figure 3.5. Illustrations of iterative design studies leading up to full prototype models.

The prototypes are based on the model investigations shown in Figure 3.6, as derived from the studies in Figure 3.5 and appearing on this page.

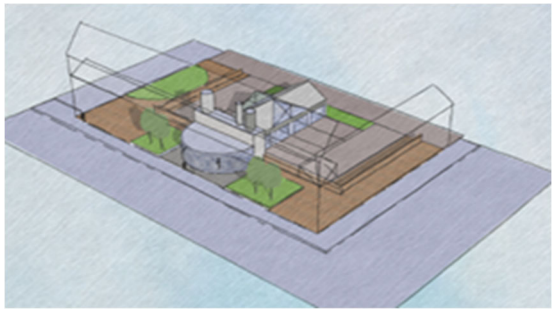
Parking structures



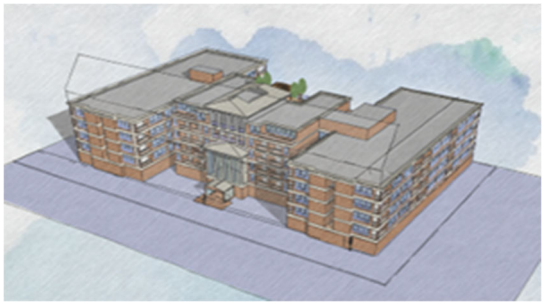
Mixed-use building with structured parking



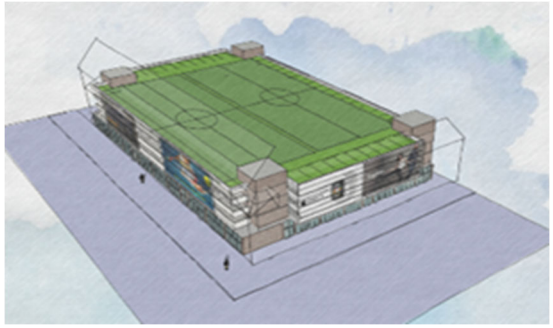
Freestanding decks



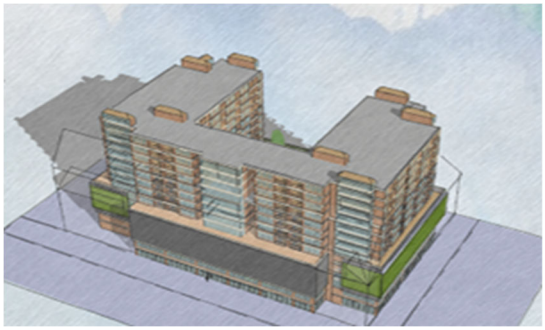
Low-rise wraparound residential and retail



Underground garage



Mid-rise residential or podium building



Freestanding mixed-use with recreation **High-rise residential mid-stack parking**

Figure 3.6. Freestanding parking decks and mixed-use structured parking solutions.

The research sequence

I. Demand assessment

The first phase of the work involves the assessment of both current and potential future demand for parking. Parking ratios are the primary factor in determining a parking structure's size, and such ratios are established to address the size and type of uses in question, the area of the site, and the degree to which multiple uses on-site can share parking allocations. In infill situations, parking structures can be sized to address district or capture zones for a collection of sites, so that adjacent properties in that zone can be serviced from a central source or reservoir of parking. In that instance, the designated bulk requirements such as height and FAR standards in the development zone determine the potential total yield or area of buildings in the district, and thus the overall parking demand.

Complicating matters is the fact these ratios are in flux as a result of changes in generational patterns of vehicle use and ownership, particularly among young single, family, and senior demographics. In *Smart Growth and Infill: Challenge, Opportunity, and Best Practices,* Listokin et al. (2007) depicts research findings on actual demand and reduced standards for urban infill. Cuddy's (2007) dissertation determines parking ratios for a variety of mixed-use residential settings. These ratios, however, do not address changing requirements, particularly with respect to the potential future impact of rideshare and driverless vehicle use. The surveys developed for this dissertation, therefore, collectively present an overview of the current state as a benchmark for parking demand in urbanized areas, particularly in infill redevelopment settings.

These surveys included:

1. A survey of census tract family vehicle ownership patterns;
2. A survey of recently approved parking ratios for multi-family sites in Northern New Jersey;
3. A review of current New Jersey Residential Site Improvement Standards (RSIS) and related to a designated mix of unit types for the residential prototype models; and
4. A survey administered to residents of a single, well-placed urban high-rise in Hoboken, NJ. This building has direct and immediate access to a light-rail connector, linking it to local and regional transit services.
5. The Visual Preference Survey™ sessions also included a series of binary questions related to the general sizing and use of parking structures and per-household automobile ownership.

II. Focus group reviews

Focus groups consisted of four groups of 10 members each. Based on consultation and input from the dissertation committee, participants represented a variety of age groups and levels of expertise and included both lay stakeholders and professional experts in the fields of architecture and planning. The sample represents a cross-section of those who design, plan, and use parking structures. This provided a basis for verifying the VPS™ results across a wider population. Participants in the final group included public officials and members of municipal planning boards, including both professionals and lay volunteers, who had an expanded capacity to focus on the

economic issues of structured parking. The focus groups were conducted for professional and lay stakeholders.

Faucett, Ellingham, and Platt (2008) investigated similar issues in the architectural field, finding the greatest differences in opinion between architects and lay users (p. 613). The three authors attribute this difference in part to architectural education itself, with its modernist dicta, as well as to peer reviews and architectural critiques that are central to the profession. Faucett, Ellingham, and Platt (2008) recorded reactions of other allied professionals, but the greatest range of difference occurred between architects and lay users according to their work.

Experts would therefore be expected to prefer models that incorporate multiple prototypes—that is, the more complex compositions of building forms and more abstract visual representations. Lay participants, accordingly, might be expected to prefer those that incorporate a single prototype: single-use, single-purpose, with more traditional and orthodox building visual representation (see Note 6 for this chapter).

Research Question 1: Exploring prototype models and the five areas of interest.

To prepare participants for the focus groups and to familiarize them with the issues relevant to the dissertation, a selection of exhibits was distributed in advance. Although the Public officials group had a slightly different agenda (i.e., their reviews also included a more detailed examination of parking costs), the sequence of events for the different groups were otherwise consistent.

Downtown infill simulation.

A video simulation of a six square-block downtown area was created to assist the focus group participants in visualizing and understanding the prototypes. In this artificial but representative development zone—"Anytown, USA"—all six prototypes provide a context and a relationship to each other, as well as to other structures and streets. The first video simulation shows a series of empty parcels, which are then infilled with alternate prototypes in the second viewing of the simulation. Framing the proposed models are streetscape envelope standards that depict base-height and setback controls as illustrated in Figure 3.7 to demonstrate zoning conformance.

Simulation of model infill setting

Opposite view of model

Ground-level view of freestanding prototype

Ground-level view of free standing prototype, with high-rise mid-stack model

Figure 3.7. Anytown, USA: Six alternates inserted in a downtown infill redevelopment setting.

The redevelopment sites selected were developed with multiple options to compare and contrast parking solutions represented by the prototype designs, as well as to simulate alternate densities, sizing, scales, massing, visual and placement solutions.

1A Low-rise wraparound model with underground garage

1B High-rise with freestanding deck

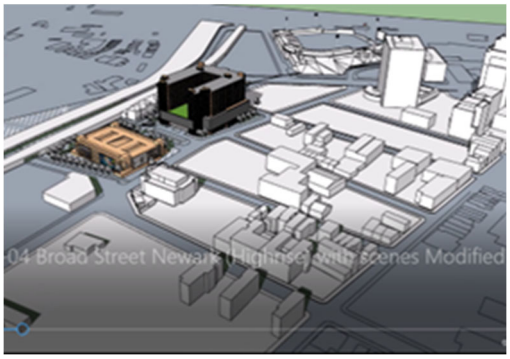
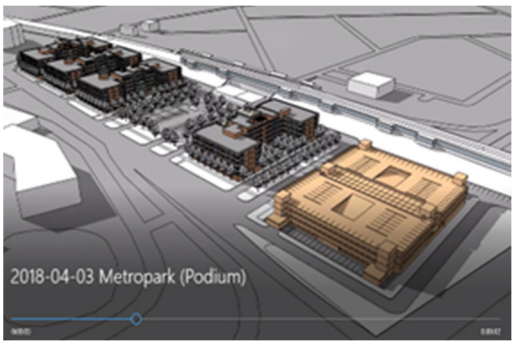


Figure 3.8. Newark, NJ Broad Street Station, Central City Urban Infill.

1A Low-rise wraparound model with underground garage

1B Mid-rise podium with freestanding deck



1C High-rise and low-rise models

Figure 3.9. Iselin, NJ Metropark – Regional Transit hub

3A Low-rise residential **3B Mixed-use combining all models**

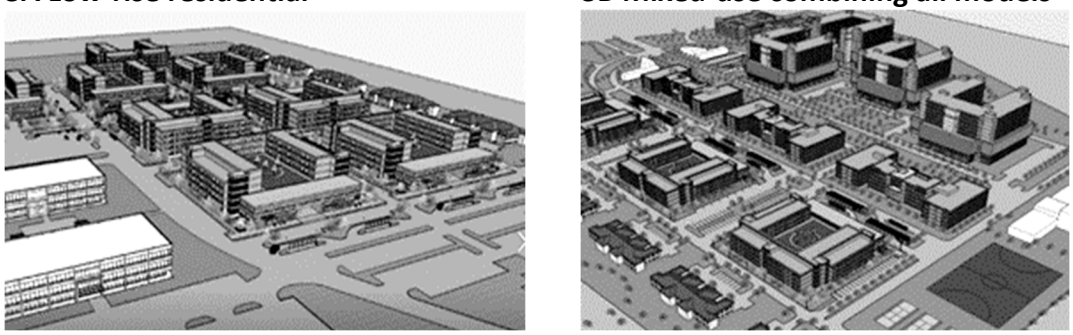


Figure 3.10. Morris County, NJ Ex Urban Cluster – Redevelopment of a Former Office Park.

Note: Illustated examples of all video simulations appear in Figures 3.8-3.10, and are detailed with additional graphic and live video depictions in Appendix B.

Research Question 2:

Future state of parking and outcomes of reduced parking demand.

A series of direct, binary survey questions were inserted into the focus group protocols (see Appendices J-1 through J-7) to address overall issues in auto usage, alternate mobility, and housing and settlement preferences. As the panels represented different age cohorts, the expectation was that responses to these questions would tend to track generationally, however this turned out not to be the case.

Using the panels to provide additional input into future state provided a further snapshot of responses to corroborate the findings of earlier survey work. Despite a relatively small sample size (40 panel members and 50 respondents overall, including the 10 professional expert interviews), the efforts addressed these questions head-on with clear results.

Additional questions related to the future state of mobility and parking structures were posed with reference to specific illustrations of both transit malls and

parking deck conversion studies. The answers to these questions are profiled with the video and graphic exhibits appearing in Figures 3.11 and 3.12.

Figure 3.11. Transit mall queuing model; Transit HUB – Suburban transit station parking deck with recreation element.

Figure 3.12. Parking structure – Graphic sequence of views in transition.

Using the binary responses, in conjunction with the cited illustrations, enables the gathering of direct responses to these issues, as opposed to the eliciting of subjective or speculative feedback. This serves as a clearer means of soliciting direct responses to these potential transitions in future redevelopment and planning policy.

III. Interviews with subject matter experts

Upon completion of the panel sessions, interviews were conducted with recognized experts in the areas of design, engineering, and parking development and management, as well as other redevelopment experts, both academic and professional.

Details of these interviews and transcripts/summaries of the discussions appear in Appendix I-2 with a summary of their comments. Whereas the focus groups consisted of architects, lay users, and citizen board members, the interviews were designed to solicit insight from professionals whose experiences shed light on a broad range of issues relevant to the development and deployment of structured parking. The one-on-one interviews included an examination of the case study results, as well as issues related to parking, its future demand, and the impact of the constraints and complexities of the redevelopment process. This group of 10 professionals provided insight into the complex process that surrounds the development of parking to meet the needs of the development community and the population it serves (see Note 7 for this chapter).

As with the panel review participants, relevant materials were distributed to interviewees in advance of the meetings. This ensured that regardless of their professional backgrounds, the participants shared a common frame of reference.

IV. The economics of parking

A detailed financial pro forma model has been developed for this dissertation that incorporates rents, developer returns, and other economic outcomes related to parking. To provide input for the model, a list of questions with economic implications

were posed in the focus groups. The responses generated a user's perspective on the cost of parking and are included in the series of financial models to demonstrate the relative economic impact of users' choice.

Those choices cover a range of issues, with implications for the five key areas of interest, including: the adjustment of parking ratios to address downsized urban parking standards, the choice of whether to include ground-floor office or retail in the structure, and the potential elimination of on street parking. The economic analysis can also address additional options not included in the VPS™: solar arrays, shared parking programs, and other physical enhancements for the benefit of security and safety (see Note 8 to this chapter).

Summary

This dissertation embraces the challenge of associating the concerns of several disciplines—public policy, urban planning, and design practice—in order to form a cohesive understanding of the constraints and possibilities for designing and deploying this building type more effectively. The multi-disciplinary approach provides both qualitative and quantitative input for this dissertation topic. The research phase of this dissertation focuses on evaluating the fundamental character and qualities that define the well-designed and executed parking facility, as it exists in a variety of settings.

Prototype models and case studies are applied to evaluate five key properties (size, scale, massing, aesthetics, and placement) to serve in the development of design guidelines and implementation strategies for urban, suburban, exurban, and downtown settings. As shown in Figure 3.13, the research effort integrates the results of the

various research components in order to develop best practice recommendations, guidelines, and implementation strategies that serve to make parking itself a more effective element in a broad range of redevelopment settings.

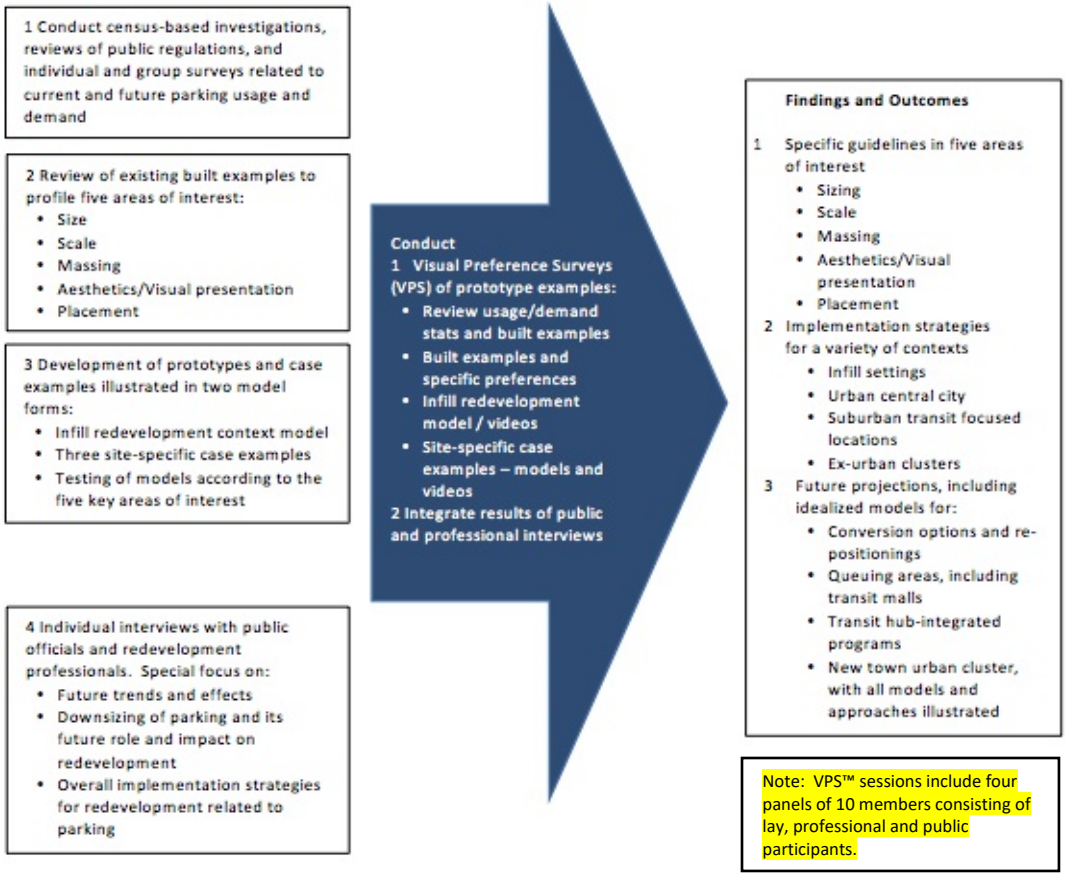


Figure 3.13. Diagram: Progression of research effort.

In seeking answers to questions about the design and development of structured parking, which is ultimately a multi-disciplinary effort, this dissertation discovers common ground for different areas of practice and consideration: engineering, architecture, urban planning, urban design, and public policy. The appendices to this document contain the full, detailed exhibits utilized in this research effort, along with analysis and illustrations depicting the origins of the prototypes.

NOTES FOR METHODS SECTION

Note 1: Basis for analogic comparisons ascribed to abductive reasoning

In lieu of either inductive or deductive theories, such cases can be evaluated via analogical comparison, identifying their similarities and differences, as opposed to the direct causal relationships associated with case theory in the social sciences. Referencing Charles Sanders Pierce, Johansson (2003) states: “The surprising fact C is observed, but if A were true, C would be a matter of course, hence there is reason to believe that A is true” (p. 9). This process can be understood as inference.

Abductive reasoning can likewise be defined as a form of logical inference which starts with an observation or set of observations, and then seeks to identify the simplest and most likely explanation for the observations. Unlike deductive reasoning, which drives to one definite answer, this process yields a plausible conclusion. Johansson (2003) recognized that although such investigations may seek “truth, applicability, consistency and neutrality” (p. 10), it is difficult to codify the results through qualitative and quantitative methods.

Julie Colhoun and Dedre Gentner (2009), both Northwestern University psychologists, address abduction and inference in their 2009 article,“Inference processes in causal analogies.” These authors explain: “Analogical reasoning provides the ability to determine similarity and to make inferences from one situation to another” (p. 1).

While their subject area concerns the tracking of biological similarities to detect underlying causal relationships, the authors maintain that observation and mapping of

similarities leads to conclusive evidence about relationships between otherwise dissimilar and non-associated subjects. Citing the maxim, “If it walks like a duck and quacks like a duck, it’s probably a duck” (p. 1), Colhoun and Gentner (2009) posit that observation and inference by analogy is a first step in developing theories that may ultimately prove to be “structural alignments” between two or more subjects.

These two authors state: “In general, models of analogy, including structure-mapping theory, postulate that the more similar two analogs are, the greater their inductive strength” (p. 1). The goal is not to prove direct causal relationships, but rather that the strength of observable relationships between the original source and the prototype model imparts a similar and related characterization for both entities.

Note 2: Sources for Visual Preference Survey™ techniques

In a 2010 Rutgers dissertation for which Professor Anton Nelessen served as committee chair, Luis Balula (Balula, 2010) similarly applied a VPS™ to a pre-assessment process in Evora, Portugal. Balula used approximately 70 images from over eight categories to form the basis for his analysis, leading to a preference-based narrative for public spaces and streets in the UNESCO-designated World Heritage city. The primary output for that dissertation, which focused on applying New Urbanist principles in a European context, consisted of comparing expert and non-expert reactions to these images and forms.

Sussman and Hollander (2015) use eye-tracking technology to eliminate inherent bias in their results. Their technique relies on involuntary optic reactions to

paired images of downtown streetscapes. This approach eliminates otherwise involuntary responses to the images—whether objectively or subjectively biased.

Note 3: Sources for prototyping methods and strategies

Camburn et. al. (2013) provide insight into the use of prototype testing to prove viability. The authors asserted that the "prototyping strategy method provides a means of translating between independent design context variables and dependent prototyping strategy variables" (p. 4). Rather than addressing all variables within a possible prototyping strategy, their approach focuses on selected variables and "includes those that were identified as the most critical to success" (p. 3).

Note 4: Sources for essential design criteria and standards

The literature review for this dissertation cites several sources as the basis for determining essential parameters for viewing parking context. Beginning with Lynch (1960) who advocates for an urban design theory that focuses on "patterns and sequences in a composed and connected whole" (Lynch, 1960, p. 158), with an emphasis on not just buildings and streets, but all elements of the city space. Both the work of Lynch (1960) and Barnett (2003), another source for defining these parameters, are connected to the field work of William Whyte (1980). Whyte's investigations of urban spaces give rise to an emphasis on placemaking consistent with urban design implementation in the planning field and New Urbanist manifestos. Project for Public Spaces is an early proponent for active and engaged public building, with an emphasis on the qualities of space and user experience. Barnett (2003) cites

four dominant themes central to this dissertation's evaluation of parking structures and their role in creating a unified urban setting (para Chapters 6-11, p. 95-210):

1. *Neighborhoods and districts as definable elements of the city network which deserve to be registered as places of individual character and image*.
   This echoes Lynch's call for the articulation of nodes, edges, landmarks, and points of connectivity when defining the city plan and the image of the places defined by those parameters.
   Barnett also emphasizes the need to integrate a variety of building types and densities in both inner city and suburban contexts to assure housing diversity and access for all. Barnett's concerns for the quality of streets and the relationship of the public and private realms frames and articulates design guidelines that emphasize street width, building height, and sidewalk dimension in the implementation of places.

2. *The development of edge places and cities with a focus on the reuse of defunct office and retail malls as targets for reemergence as coordinated and balanced urban places*.
   This dissertation used the term *exurban clusters* to define areas on the periphery of major cities where urbanized centers can be enhanced by good design and planning guidelines.

3. *Linkages to transit and the development of identified zones surrounding these assets*.
   In the current dissertation, these were termed *walkable distances*, similar to standards found in literature in the area of transit development.

4. *A focus on existing urban downtowns and the balancing of elements required to assure continued vibrancy and relevance*.

With respect to parking, Barnett (2003) offered several basic parameters for surface parking lots in multiple contexts. These approaches to surface parking were integrated into this dissertation to serve as bases for the profiled structured parking prototypes. Those parameters include the five principal criteria of interest as follows (para Chapter 12, p. 210-246).

1. Sizing: Keying parking standards to their specific contexts and recognizing the importance of shared parking programs and parking as maximum standards (based on the work of Donald Shoup in this regard), as well as incorporating

different styles of parking to meet consumer/user, developer and financing entities expectations.

2. Scale and Massing: Respect for zoning heights and an appropriate relationship of building height to street width depending on the context and setting (Note that scale and massing are distinct criteria within this dissertation, but are treating collectively by Barnett).
3. Visual: Focus on the quality of the architecture and its local and vernacular quality, as well the maintenance of active street walls with retail frontages in downtown areas to supporting street life and creating defendable, observable and active spaces.
4. Placement: Location of parking, especially surface parking, away from major avenues where these elements might otherwise create dead zones along the street space. Create parking access from minor streets and alleys in the interest of maintaining a continuous walkable street front without interruption by curb cuts and other hazards to pedestrian movement.

Note 5: Review of parking deck criteria as the basis of prototype designs

Option 1. Dual bay with a single ramped floor. When examined as dual bay decks these ground rules were observed:

1. Utilization of a single, sloped bay of 18 cars and an external parked ramp of 190-feet;
2. Position ramps to the inside of the block allowing the exterior face of the ramp to remain level over its full length;
3. The maximum pitch along this parked ramp corresponds to a recommended 5.5-degree slope, indicating that to achieve a nine-foot floor-to-floor height, that lane would require 200-feet of length (corresponding to the 18-car capacity per bay);
4. The overall depth of the structure corresponds to two 62-foot bays (19-feet plus 24-feet plus 19-feet), i.e., 122-foot overall width meeting the constraints for infill along a single-block frontage.

Option 2. Triple-bay with a single internal speed ramp or parked ramp. When examined as triple-bay decks, these ground rules were observed:

1. Position ramps to the inside of the structure to allow all exterior faces of the deck to remain level along its full perimeter.
2. The maximum pitch along this access-only speed ramp corresponds to a recommended 11% slope, indicating that to achieve a 9-foot floor-to-floor

height, that lane would require 100-feet of length (corresponding to the 10-car capacity per bay).

3. The overall depth of the structure corresponded to three 62-foot bays, 186-feet in overall width.

The implication of this approach is that a full through-block assemblage is required to meet the needs of the configuration; alternatively, a deck would need to be situated at the end of the block, oriented depth-wise relative to the frontage (see Appendix D).

Note 6: Predicted preferences for Lay and Professional focus group members

The differences in the visual preferences of architects and the Lay public is addressed in *Reconciling the architectural preferences of architects and the public: ordered preference model* (Faucett, Ellingham & Platt, 2008, p. 615). These researchers focused on the statistical differences in recorded preferences among a mix of respondents to speculative office buildings in southern Britain. Respondents included architects, developers, planning consultants, investors, real estate agents, and laypeople.

Note 7: Professional Interviews with subject matter experts

In the area of agency affiliations, interviews included transit agency professionals and parking authority executives whose role includes transactions directly engaged in parking-related projects. Interviewees included a transit authority real estate executive and a parking authority executive director. In the area of redevelopment, interviewees included planners, traffic and civil engineers, and lawyers

whose area of work engages in redevelopment, with particular focus on projects involving parking and transit-related development.

In this area of research, interviewees also included nationally-published authors on the topic of parking, with an industry and design focus. Those interviewees included a parking industry consultant and spokeswomen, an author and academic who served as the principal organizer of the National Building Center's *House of Cars* exhibit, and the a senior official of an organization devoted to issues including form-based codes.

Developers were also consulted, given their central role in the decision-making process in the design and financing of parking. Those interviewees consisted of executives from local and national development and redevelopment firms.

Note 8: Financial parameters for pro forma analysis of cases

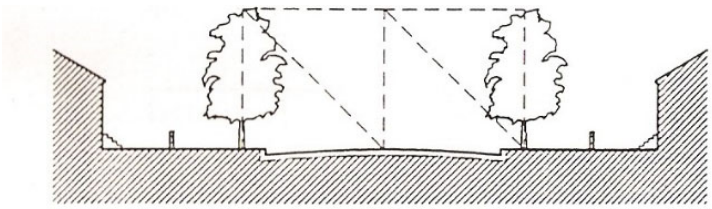
Bier et al.'s (2006) *Parking Matters* provided a series of pro formas for publicly built garages. These parameters were incorporated into the pro formas developed for this dissertation, with respect to yield, equity returns, cost of leverage, and other factors. This dissertation also included a reversion factor based on an acceptable cap rate 7 years after stabilization in order to provide an overall basis for an internal rate of return (IRR) and cash-on-cash return calculation.

Note 9: Street scale assessments

According to Allan Jacobs (1995) and Stanford Anderson (1978), the development of streets requires integration of dimension and scale. To this end, a variety of both narrow and wide street widths were overlaid on the case studies. This enabled the measurement of relative scales and dimensions of the prototypes in

settings reflective of the typical building base and building street-wall heights found in urban design guidelines. Derived from long-embraced techniques in city planning, these approaches have recently been integrated into the New Urbanism's transect system, a principal component of the form-based codes being adopted on a widespread basis.

A variety of base-heights and sky planes for differing street configurations have been developed by examining historic city spaces and the relationship of façade to setback and to overall height. These techniques were integrated into the prototype models and downtown infill video presentations.



The results of the focus groups provide direct insight into issues of both massing and scale in each settings. These conclusions in part served as the basis for guidelines and strategies for future implementation, especially in the context of the development of appropriate and well-scaled streets and public spaces.

Note 10: Architectural aesthetics and urban planning theory

Discussion of architectural aesthetics, in contrast to urban design standards, addresses issues of the post-modern decorated sheds and its relationship to historic guidelines and design standards that emphasize the relationship of the private realm (i.e., buildings) to the public realm (i.e., street). The literature review includes an extended discussion of this topic.

Note 11: Street design and sky plane and setback standards

These techniques were drawn from a list of sources in the area of street scale and bulk regulations, including Lynch (1960), Barnett (2003) and Cullen (1961), as well as a variety of standards adopted into New Urbanist codes based on historic city building standards. In *Visions for a New American Dream*, Anton Nelessen (1993) cited a variety of similar bulk standards for small scale communities and infill settings, adopting the concept of base building heights, envelopes and setback standards derived from typical building forms, spanning the spectrum from free-standing single family residential neighborhoods to mixed-use and commercial settings.

CHAPTER 4. FINDINGS

Introduction and overview

This dissertation identifies the elements required to create structured parking that is well placed, contextually appropriate, and in alignment with users' stated preferences. Examining the results through the lens of public policy implications enables the creation of implementation strategies and design guidelines for parking in urban, suburban, and exurban places.

Part 1: Principal findings and best practice models

The findings of the research and the three best practice models developed from the findings are presented in this chapter. The Appendix contains all data and additional findings in detail.

The five key properties are appropriate and applicable

The results of the research confirm the applicability of the five key properties of sizing, scale, massing, visual representation and placement, and their relevance to both professional and Lay respondents. Respondents across the board were able to understand, differentiate, and rank these properties in order of importance, thereby generating insights critical to developing best practice models. The participants' rankings also allowed for the identification of group biases, normalization of results, and validation of the assessments of individual VPS™ responses to the prototype and case simulations.

Professional expertise proved to be more significant than respondent age and generational cohorts in these results. Panel results were evaluated specifically to assess

the impact of generational status. The results of a linear regression, holding panel membership constant demonstrated no direct correlation between generational status and responses. As revealed by linear regression, panel responses by expertise were statistically significant. Similarly, responses vary to a narrow degree between demographic cohorts, as illustrated by responses to the test cases and simulations, and by the examination of the five key criteria.

When averaged across all participants, regardless of panel participation, the criteria ranked as follows: (a) visual, (b) placement, (c) sizing, (d) scale, and (e) massing. An in-depth exploration of the statistical rankings of the five criteria follows these principal findings. The results of this study, and the best practice models developed from it, demonstrate that as a framework, this set of five criteria can be applied in addressing a range of problems in planning, urban design, and architecture.

The five criteria represent the framework through which Implementation standards and Design guidelines were structured. Because of the clarity of responses from the VPS™ sessions, these criteria have been reflected in a set of best practice models. The models serve as further iterative examples of how these guidelines can be applied for a number of parking typologies. Freestanding transit hubs, mixed-use residential buildings and underground garages were profiled. Further versions of these models and other alternate site-specific iterations of these prototypes can evolve from these basic models. The implementation standards, the design guidelines, and the best practice models are provided for a more detailed examination in Appendices C and D.

Additionally, Chapter 4 provides a detailed review of the best practice models on a criteria-by-criteria basis under the heading Notes to Findings Chapter**.**

VPS™ results conclusively set a direction

Panelists across groups consistently preferred the same three of the six representative prototypes tested, in both the downtown infill simulation and seven case study simulations. In order of preference, these prototypes were:

1. The transit HUB freestanding parking structure with integrated retail uses and recreation deck (Figure 4.1);
2. The low-rise wraparound residential mixed-use structure with integrated retail and recreation deck (Figures 4.2-4.4);
3. The underground garage, with the caveat that the preference for this option can be driven down by potential cost, particularly for an automated system (Figures 4.5-4.6).

The preference for low-scale, low-density, low-impact, and multi-use solutions pointed to a larger desire for structures that integrate with both the overall environment and dynamic character of their settings.

Best practice models

Three highly ranked VPS™ models constitute the best-case practice proofs of this research and were developed using data and insights from across the full spectrum of this research effort: the prototype models, VPS™ responses, direct input from panel members, as well as professional, academic and expert input, and the urban design and

city planning standards found in the literature. The models in Figures 4.1–4.6 reflect respondents' stated preferences for placement and visual treatment.

The highest ranked prototype is the Transit hub (Figure 4.1) presented here as part of a community rail stop in a downtown setting with accompanying retail, athletic, recreational and affordable housing uses integrated.

Figure 4.1. Transit hub design prototype.

The second ranked prototype, (Figures 4.2 and 4.4), is a residential mixed-use building with wrap-around parking deck, it is intended for infill settings in downtown areas, and as a basis for larger new development proposals in exurban developments. The rendering depicts this option in both urban and exurban settings. The implementation in both contexts represents real users' preferences for placement and visual treatment as captured in the VPS™ (see notes section to this chapter for a narrative description of each best practice model).

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Figure 4.2 Low-rise, wraparound, mixed-use residential building.
Suburban and exurban cluster option: low-rise, with integrated multi-layer parking, mixed-use housing, roof deck upgrade, retail and office uses with bus/transit mall, and event space

Figure 4.3. Urban option (full block or partial-block infill), mixed-use residential wraparound with integrated multi-layer parking, roof deck upgrade and retail and office use.

Figure 4.4. Photo montage of same Hoboken infill site.

Integrated into an urban setting, this rendering depicts the wrap around, low-rise residential model as a full block infill in Hoboken, NJ.

Extending iterative design studies to underground parking

The concept shown in Figures 4.5 and 4.6 depicts an alternate approach to underground parking and was developed using the same iterative design process as in the creation of prototype models, simulations, and cases for this dissertation. This alternate prototype was created to address user preferences, as well as to address the two greatest contributors to the cost of underground parking: (a) intense structural frame requirements; and (b) mechanical venting.

Figure 4.5. Underground parking with athletic recreation deck – addresses the extreme cost of this building type in an on-campus.

The concept for a modified underground garage eliminates heavily reinforced perimeter walls, and instead frames the deck itself with a lightweight steel frame. The resulting full-perimeter exposure eliminates the need for a costly mechanical venting system. The model also incorporates two upgrades that reflect users' stated preferences: a domed recreation deck and green walls.

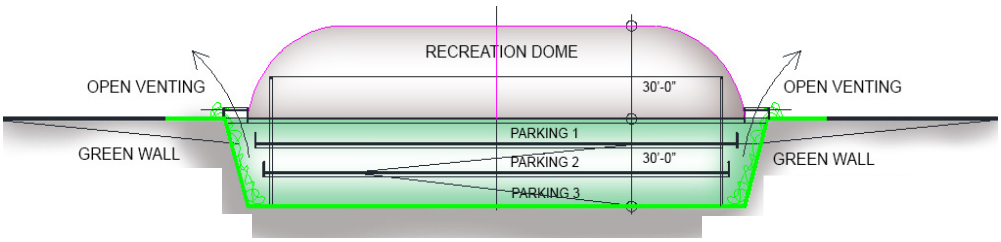
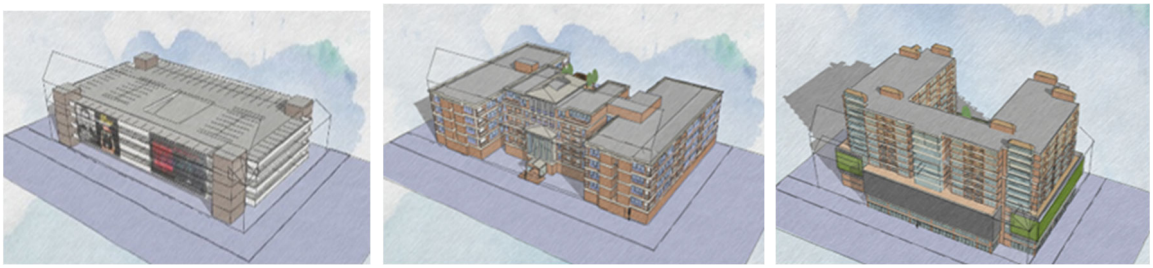


Figure 4.6. Rendered cross-section.

The concept also includes the possibility of a key block system, slurry, or stepped/rammed-earth perimeter-walls. The pro forma models conducted for this study confirm the low cost of both upgrades.

Note: Architectural and section details for all Best practice models are available in Appendix B.

What the panels rejected and other interesting observations.



Adopted from Figure 3.6. Freestanding parking decks and mixed-use structure parking solutions.

Low scoring model prototypes.

The models depicted above were the least favored options selected by the panel members. Individually taken, there were a variety of responses, however on a pooled basis (see Figures 4.8 and 4.10 and Appendix E), the respondents generally rejected these alternatives. Further discussions provided later in this chapter are directed at these choices.

Contrasting assessments of visual quality.

Another set of interesting contrasts looks at several ratings for the visual quality of the built examples. See Figure 5.1 and illustrations below.

No. 7 - Kansas City, MO Central Library parking deck (see Figure 5.1 for full details).

The skin of this parking structure was not designed by an architect but rather by a graphic designer – this thematic visual treatment scored lowest with Senior architects (-1.5) and highest with Lay persons (+7.5), a 9.0-point range.

Is this a comment on formal versus provincial architecture, a comment on cultural standards, kitsch in design, or simply the desire to be more expressive, light-hearted and engaging?

An on-point insight from a Lay participant criticized this structure for its lack of transparency with a concern for safety and lack of visibility.

No. 10 - Lincoln Place Garage, Miami Beach, Fl. (see Figure 5.1 for full details).

With equal disparity in visual ratings, this brutalist South Beach parking deck evoked disagreement between the architectural panels. Seniors architects actually voted it as their lowest of all choices (-1.5), while Millennial architects voted it as their highest (+7.5), again a 9.0-point range.

What does this say? Do Senior architects reject modernism and rationalism later in their career, while young architects embrace it? This structure clearly speaks to the tectonics of building and architecture as an expressive art form.

These contrasts present an interesting, unexpected and perhaps vexing outcome.

Figure 4.7 – Contrasting observations for the visual quality of two built structures.

Podium structures versus the mixed-use high-rise prototype

One distinction should also be made—the differences between the podium building and the high-rise structure illustrated. Podium buildings have come to be understood as structures built of framed wood construction over a concrete or steel platform, or "podium", that can accommodate one or two floors of retail, office, and parking, or combinations thereof. A high-rise structure is distinctly different and entails the fashioning of a mixed-use building of either steel frame or concrete construction.

The chief distinction between the two forms is that the hybrid steel/concrete/wood building, or the "podium" building as it is generically defined, is limited to an overall height of four to five stories depending on the local jurisdiction. On the other hand, the steel and concrete high-rise can achieve unlimited heights. The high-rise model used in this dissertation is adapted from many similar in-place examples of mixed-use, mid-stack parking structures, including Marina Towers in Chicago, Il (see Figure 2.7). Marina Towers is perhaps the first and most expressive example of this building form and was constructed in the mid-1960s.

Putting all of that aside for a moment, the panels valued these models at a considerable discount in their ratings versus the three best-case practice models illustrated in the following renderings and text. Overall, density was only one issue, though how and in what ways these building models interacted with the street space provided another significant distinction based on panel member responses.

Upgrading parking is a minor cost in the larger cost of redevelopment

All focus group participants perceived the construction of parking to be expensive; however, the pro forma generated for this dissertation demonstrated that while several approaches can represent a significant cost, well planned, correctly sized and well configured parking is only a minor component of the larger cost of redevelopment. Further, the incremental cost of making specific upgrades to parking in order to satisfy users' stated preferences adds little to the overall cost of the total development effort. The impact on total development costs and monthly rents are clearly depicted in the exhibits and narrative descriptions that precede this section, and this dissertation indicates that parking, in contrast to common understanding and perception, is only a minor component of overall development costs when properly sized and configured.

The future state is uncertain, with one notable exception

Responses to binary questions in many areas—such as visual representation, and issues of height scale and massing—were conclusive, with a small variance between panels. The results for a number of binary questions were inconclusive, however, although preferences from these panels were expressed—even at this small sample size,

it was telling that the common trait of the inconclusive results is that they concern future trends. It was not possible to draw any significant public policy implications from these findings, a fact that points to the need for further research in this area.

However, as a means of benchmarking these trends, this dissertation clearly depicts the current state of awareness and acceptance of these evolving changes in automobile ownership and parking demand.

Personal vehicle ownership.

The projected reduction in vehicle use and ownership through the adoption of autonomous vehicles that is being trumpeted by both transportation planners and the automotive industry garnered a mixed reaction among panel participants. One public board member from an urban county remarked: “Reduced auto dependency, adopting rideshare and public transportation are radical assumptions.” This remark suggests that at least in this one participant’s opinion, the elimination of private vehicles in favor of transit, rideshare, and future fleets of autonomous vehicles was unrealistic.

Millennials do, however, have lower rates of vehicle ownership. Even when they own a vehicle, they do not recognize it as a full-time necessity. As one panelist in the Millennial architects group stated, “I need my car all the time [for work] but on the weekend I don't even move—it sits there until Monday.” Senior architects and Gen X panel members generally expressed a not-in-my-lifetime attitude (e.g., “You’re trying to take my license away!”) and were circumspect as to whether fully autonomous vehicles will become a feasible alternative for family automobile ownership.

Public transit not a readily reliable alternative to vehicle ownership.

Transit-located, accessible parking was favored across the board. Panel members, however, voiced concern that public transportation systems as they exist today are seriously overburdened, overcrowded, uncomfortable, and unreliable. Further, as member of the Senior architects panel stated: “Summit and Madison, Morristown are completely different from Newark and New York City.” This indicates that abandoning automobile ownership and use in favor of public transit is not applicable as a solution in all contexts. The problem of overcrowding as well as the unreliability of transit as a commutation alternative was cited repeatedly by participants. These panel members also described cancelled schedules and late arrivals as examples of problems that appeared to be unsolvable.

Downsizing, but not necessarily urbanizing.

The participants appreciated—but did not embrace—the prospect of increasing settlement in urbanized living environments. The preferences of panel members, predominantly suburban residents, were for single-family detached homes during child-raising years, and townhouse settings for later in life. A majority of panel members expected to downsize to townhomes or apartments as they age, and generally accept the fact that their parking demand would correspondingly decrease. For many, however, this did not mean “urbanization.” A panelist in the Public officials group stated, “It doesn't mean Hoboken, or Jersey City. It could be ... downtown Madison. Downtown Chatham? Yeah.”

Street parking preferred, despite drawbacks.

The participants generally rejected any proposal that limited on-street parking, even with the potential benefits of greater open space, enhanced pedestrian activity, and improvement of the overall quality of the urban experience. Respondents understood that the majority of downtown congestion stems from drivers circling for the right curb-side space, but they resisted the elimination of on-street parking. This remained true even when presented with a multi-level structured deck as an alternative. “People will do that [circle the block] for 40 minutes before they’ll go into a parking garage,” commented a member of the Senior architects’ panel.

Parking ratios.

Despite their inconclusive responses to questions regarding various aspects of the future state of mobility and parking, respondents generally recognized that a reduction in parking demand is currently in progress. As predominantly vehicle-dependent suburbanites, their personal vehicle ownership per household ratios were greater than 2.0. Their responses to questions about a potential reduction in parking ratios corroborated the results of parking and demographic surveys conducted in a number of New Jersey communities. These results justified the ratios used in this study, which ranged from 1.0 -1.65, depending on the setting. Appendix G provides the survey results in detail.

Results validate both research methodology and urban planning standards

Research methodology.

The combination of iterative design, prototyping, and Visual Preference Survey™ techniques is a protocol developed to address an urban design and planning problem with public policy implications. Its successful implementation makes it a suitable and replicable technique for addressing similar problems that call for investigations into facility planning, architectural design, and urban design—particularly efforts to qualify and quantify findings in the area of evidence-based design.

Urban planning standards.

Although not specifically sought as an outcome, both the qualitative and quantitative research results validate the importance of traditional city planning and urban design parameters. In almost every instance, no matter how it was presented to respondents, whether as specific simulations or as direct questions about specific issues, focus group members affirmed the importance and relevance of parameters, including the use of base-height, setback, and sky-plane regulations over the use of floor area ratios; mixed-use structures; and active retail frontages that engage with the street space.

The only area in which the focus group members' preferences significantly diverged from the urban planning literature was in the area of visual representation. Participants consistently favored reproductive or traditional treatments for structures located in a downtown or urban context, which stands in contrast to the findings of Henley (2007) and McDonald (2007), who asserted there was no need for parking

structures to be radically adorned or disguised to distract from their function. These authors preferred the celebration and expression of the intrinsic qualities of these engineered forms were these authors preferred approach. Panel respondents felt that such expressive visual treatments were appropriate chiefly in isolated or remote areas, or potentially in the case of integrated structured parking in mixed-use buildings.

Criteria rankings for prototypes and cases.

A summary of panel responses to the five criteria follows in the Appendix, along with rankings for each case and prototype by category. Panel results are provided on both a pooled and individual basis for an aggregate score of all panels and by each individual panel. For quick reference, the pooled responses appear in Figures 4.8 - 4.10.

Group 1	Lay people.												
1.1	1.2	1.3	1,4	1.5	1.6	1.7	1.8	1.9	1.1	Total	Average	Weight	Revised
0	5	10	0	5	5	10	0	10	5	50.00	5.00	0.65	3.25
0	0	10	0	5	5	10	0	0	5	35.00	3.50	0.67	2.33
-0.5	0	10	0	5	5	10	0	0	0	29.50	2.95	0.65	1.92
-0.5	5	10	-5	0	-5	0	-5	5	-5	-0.50	-0.05	0.93	-0.05
10	10	10	5	10	10	5	-5	5	0	60.00	6.00	0.88	5.30
								Overall score		174.00	3.48		2.55

No.	Item
	Code No = 0 Yes = 1 Values = -10 to + 10
Prel.	Test cases
1	Large scale infrastructure, Newark airport, Newark, NJ
	Sizing
	Scale
	Massing
	Aesthetics / Physical representstion
	Placement
	Overall score

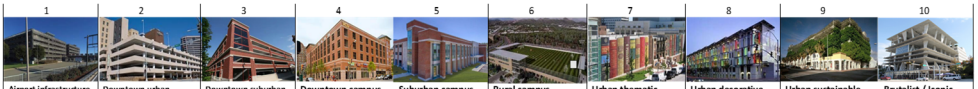
Chart 4.8. Sample response chart utilized in VPS™ evaluations.

For each exhibit, survey respondents provided a rating between -10 to +10 for each of the five criteria. A total of five scores was produced for each exhibit reviewed (see scoring sheet example provided in Chart 4.8 for one exhibit and one focus group, the

Lay members). Understanding the basis for the raw vs weighted scores helps explain the variances or differentials found in the panel to panel analysis of exhibits and simulations. Following the tabulation of panel results, an average raw score was assembled, which consisted of a total value of all criteria, the raw or unweighted score—in the case above, a score of 3.48.

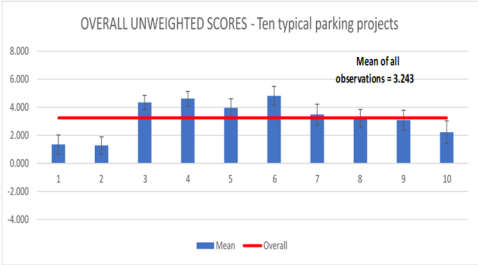
Chart 4.8 illustrates that this total was then factored by a value representing the panel types' collective consensus on the ranking of each criteria. That rating is based on discussions which occurred at the close of each session. The resulting factored score represents the weighted score for that exhibit when totaled and weighted for that individual focus group panel. In this case, the weighted score is 2.55. By approaching scores on this basis, the biases of each panel in terms of their relative valuation of each of the five criteria are integrated into the ratings and results. The resulting scores, when averaged among all focus group panels, represents the pooled value of the evaluations for each focus group panel. Charts 4.9-4.11 show the weighted and unweighted results for all panels on an aggregate basis.

1 - Ten built models – Focus group preferences



1	2	3	4	5	6	7	8	9	10
Airport infrastructure Newark	Downtown urban Greenville	Downtown suburban Downers Grove	Downtown campus Richmond	Suburban campus Johnson City	Rural campus Colorado Springs	Urban thematic Kansas City	Urban decorative Los Angeles	Urban sustainable Miami/South Beach	Brutalist / Iconic Miami/South Beach

Project	Mean	Overall	Std. Deviation	95% margin of error	Std. Err. of the mean	p-value t-test mean > 0	significant at 95% conf. level
1	1.356	3.243	4.893	0.674	0.342	0.000	1
2	1.280	3.243	4.466	0.615	0.312	0.000	1
3	4.351	3.243	3.679	0.507	0.257	0.000	1
4	4.624	3.243	3.747	0.516	0.262	0.000	1
5	3.956	3.243	4.808	0.662	0.336	0.000	1
6	4.817	3.243	4.836	0.666	0.338	0.000	1
7	3.485	3.243	5.357	0.738	0.374	0.000	1
8	3.224	3.243	4.586	0.631	0.320	0.000	1
9	3.088	3.243	5.060	0.697	0.353	0.000	1
10	2.225	3.243	5.752	0.802	0.407	0.000	1



Project	Mean	Overall	Std. Deviation	95% margin of error	Std. Err. of the mean	p-value t-test mean > 0	significant at 95% conf. level
1	1.030	2.58	3.930	0.541	0.274	0.000	1
2	0.971	2.58	3.651	0.503	0.255	0.000	1
3	3.472	2.58	3.079	0.424	0.215	0.000	1
4	3.682	2.58	3.033	0.418	0.212	0.000	1
5	3.143	2.58	3.951	0.544	0.276	0.000	1
6	3.862	2.58	3.942	0.543	0.275	0.000	1
7	2.798	2.58	4.399	0.606	0.307	0.000	1
8	2.578	2.58	3.701	0.510	0.258	0.000	1
9	2.480	2.58	4.148	0.571	0.290	0.000	1
10	1.774	2.58	4.701	0.655	0.332	0.000	1

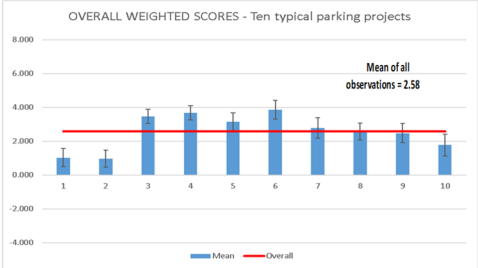
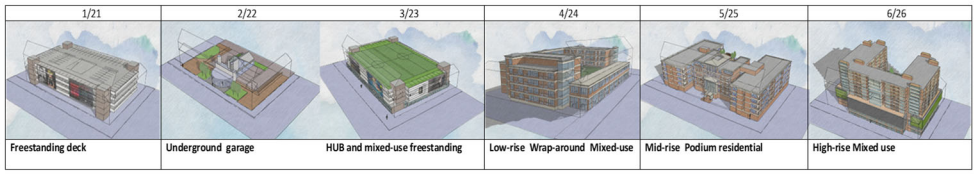


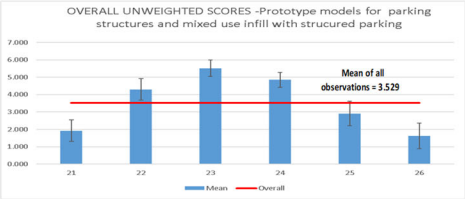
Chart 4.9. Overall pooled scores for ten built structures – VPS™ results

Additionally, a set of results isolate individual group's responses on the basis of individual criteria tested, and those charts are shown in the attached link as well as in the appendix. The individual results allow a detailed look at the differential in responses on a raw basis. Each set of exhibits by focus group panel was again presented on a weighted or unweighted basis. (See Appendix E-1 to E-6 for detailed review of VPS™ focus group scoring of simulations – a full narrative review of these results appears in that section as well) .

2 - Six prototypes – Focus group preferences



Project	Mean	Overall	Std. Deviation	95% margin of error	Std. Err. of the mean	p-value t-test mean > 0	significant at 95% conf. level
21	1.920	3.529	4.438	0.619	0.314	0.000	1
22	4.299	3.529	4.492	0.620	0.315	0.000	1
23	5.520	3.529	3.495	0.482	0.245	0.000	1
24	4.849	3.529	3.033	0.424	0.215	0.000	1
25	2.910	3.529	5.013	0.699	0.354	0.000	1
26	1.625	3.529	5.285	0.737	0.374	0.000	1



Project	Mean	Overall	Std. Deviation	95% margin of error	Std. Err. of the mean	p-value t-test mean >0	significant at 95% conf. level
21	1.470	2.79	3.573	0.498	0.253	0.000	1
22	3.383	2.79	3.622	0.500	0.254	0.000	1
23	4.396	2.79	2.892	0.399	0.202	0.000	1
24	3.851	2.79	2.483	0.347	0.176	0.000	1
25	2.296	2.79	4.020	0.560	0.284	0.000	1
26	1.330	2.79	4.203	0.586	0.297	0.000	1

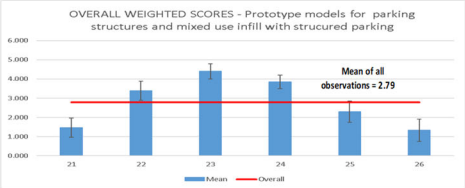
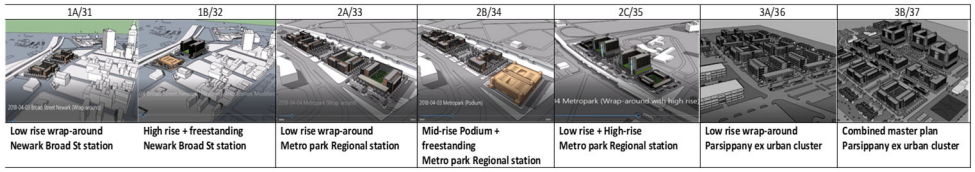
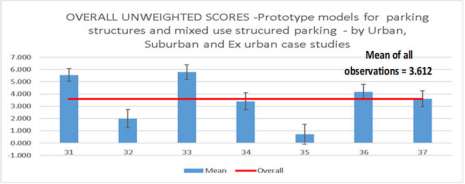


Chart 4.10. Infill simulation: Overall pooled scores for six parking prototypes – VPS™ results.

3 - Seven development options evaluated at three case locations – Focus group preferences



Project	Mean	Overall	Std. Deviation	95% margin of error	Std. Err. of the mean	p-value t-test mean > 0	significant at 95% conf. level
31	5.558	3.612	3.686	0.514	0.261	0.000	1
32	1.985	3.612	5.352	0.746	0.378	0.000	1
33	5.800	3.612	4.148	0.586	0.297	0.000	1
34	3.408	3.612	4.883	0.699	0.354	0.000	1
35	0.711	3.612	5.798	0.821	0.416	0.045	1
36	4.175	3.612	4.381	0.611	0.310	0.000	1
37	3.603	3.612	4.682	0.655	0.332	0.000	1



Project	Mean	Overall	Std. Deviation	95% margin of error	Std. Err. of the mean	p-value t-test mean >0	significant at 95% conf. level
31	4.402	2.86	3.031	0.423	0.214	0.000	1
32	1.614	2.86	4.280	0.597	0.303	0.000	1
33	4.544	2.86	3.284	0.464	0.235	0.000	1
34	2.654	2.86	3.907	0.559	0.283	0.000	1
35	0.618	2.86	4.589	0.650	0.329	0.031	1
36	3.262	2.86	3.488	0.486	0.247	0.000	1
37	2.863	2.86	3.771	0.527	0.267	0.000	1

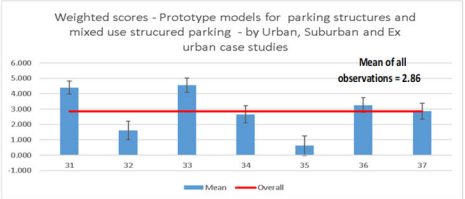


Chart 4.11. Overall pooled scores for three development cases – VPS™ results.

Part 2: High-level research results – Narrative and detail

The five key properties

Understanding the biases each panel brings to the VPS™ sessions was an important point of inquiry that helps clarify one set of panel responses to another. In order to isolate those biases, individual panels were asked to rate the importance of criteria themselves, and those ratings were tabulated on a pooled and individual panel basis. The pooled responses that appear in Appendix E-5 show mean values for each of the five key criteria: sizing, scale, massing, visual, and placement.

The merging of all individual group biases resulted in the distribution shown. Each panel was asked to rate the value of an each "individual criteria" outside of any exhibit or simulation, and on a 1 to 10 scale. The resulting score appears in the left column of Table 4.1. These scores were divided by a factor of 10 to create a ratio that could be applied to all exhibit scores for purposes of weighting individual responses for that group.

To assess the range of differences between the criteria ratings, the factored scores were totaled, and the average or mean value of all ratings was calculated. The difference between individual criteria ratings and the mean represent the factor appearing in the column "Diff." in Table 4.1.

The percentage presented in the last column indicates the variance between an individual criteria's rating and the mean. In this case, Massing received a score of -11.58% less than the mean, while Visual received a score of +14.72% more than the

mean. The total spread or range is then 26.3% across all criteria, representing the aggregate difference in value of all criteria for all four focus group panels.

Further detail on the ratings of criteria appears in the Methods chapter. The detailed differentials represent the group biases for each panel as evaluated and are described in the chapter section labeled Group Biases in this chapter.

Aggregate and all individual scores for al panels				**8.19**
Criteria	**Score**	**Factor**	**Diff**	**As a %**
Sizing	7.17	0.72	-0.06	-7.58%
Scale	7.10	0.71	-0.07	-8.48%
Massing	6.86	0.69	-0.09	-11.58%
Visual / Aesthetic	8.90	0.89	0.11	14.72%
Placement	8.76	0.88	0.10	12.92%
Average	7.76	0.78	0.00	0.00%

Table 4.1. Overall aggregate ranks for all participants

When averaged across all participants, regardless of panel participation, the criteria ranked as follows: (1) visual/aesthetics, (2) placement, (3) sizing, (4) scale, and (5) massing. The breakout of detailed findings for each panel appears in Appendices E-4 through E-6 and represents the equivalent factors shown.

Those numbers represent the aggregate of all group biases for the five criteria. All responses were tested on a pooled and individual basis for significance, and all variances were within an acceptable 95% confidence level limit. For this reason, further analysis of the criteria breakouts is supplemental and listed here as an area for continued research and investigation.

The five key criteria were used in this study as a basis of comparison for the 10 built examples, developed prototype models and case specific examples. The tables and graphs that appear in Appendix E extract panel-generated profiles for each set of comparative models studied.

VPS™ results conclusively set a direction

Narrative.

The VPS™ ratings, when coupled with the results from direct survey responses and the participants' remarks from the group discussions, paint a picture of panel members' preferences with regards to structured parking. As this review shows in Figures 4.9-4.11, underlying this complete picture is an ambivalence about structured parking itself, which can essentially be described as cultural bias. As a Senior architect described the typical driver, "They'll avoid a parking garage at any cost."

These same VPS™ results, however, point the way toward constructively addressing this bias. That is, the creation of structured parking that is well-placed, accessible, incorporates mixed-uses, and serves as integrated asset of a townscape that is contextually appropriate, marries well into its setting, and does not call attention to itself.

Preferred approaches to structured parking.

In all tests and simulations, the respondents preferred three prototypes: the low-scale, integrated Transit HUB; the low-rise, wraparound, mixed-use residential option; and the underground garage. In terms of visual representation for the Transit hub option (See Figure 4.1), respondents preferred façade treatments in traditional materials and downtown building motifs. For the low-rise option (See Charts 4.9-4.11), respondents highly rated the contemporary façade of metal and glass.

Stand-alone, solitary, single-use structures, and high-rise mixed-use structures did not rate highly, regardless of their exterior wrap or skin treatment. In terms of visual

representation, structures that are self-expressive in a rationalist or modernist mode fall to the very bottom of the list. Respondents understood that for a variety of reasons, including cost and precedent, such structures would continue to exist. The VPS™, responses however argue that such structures be scaled to their surroundings and include active street-fronts.

This is corroborated by other expressed preferences, including that of access from minor streets and alleys as opposed to main thoroughfares, so as not to disrupt pedestrian movement and safety with curb cuts. It is simple enough to infer from the above the overall preference that structured parking should either integrate fully into the environment in terms of scale, aesthetics, and human activity, or be completely out of sight.

Only when structured parking is presented outside a developed context are respondents willing to consider radically different solutions, such as inventive screens and multi-layered glass and metal treatments. In every case, panel members stressed the relationship between visibility, transparency, and safety.

Functionally speaking, respondents preferred self-parking over tandem spaces and valet services that would otherwise accommodate greater density and long-term stays. One panelist described structured parking a “last resort” to be considered only after other options are exhausted—including on-street and open-field lots. All of the above correlates with the results from the direct surveys conducted on the matter, as well as discussion in the focus groups.

The enigmatic and ubiquitous podium building.

In terms of the VPS™ results, the mid-rise podium approach to housing and structured parking is in a special category of its own. Occupying a middle to low-position in the ratings, this structure is often built without active street faces, and can occupy full blocks in the urban environment—Hoboken, NJ is a case in point. This, however, is perhaps the most "unsettling" approach of all the options examined.

Perhaps due to the sheer ubiquity of this type of structure, the Lay panel scored this option higher than did the other three groups. Interestingly, however, on a pooled basis it scored slightly below the mean in the downtown simulations, but squarely at the mean in the case study in which it was utilized. This revealed that as the average performer of all the alternates reviewed, it also presents the most mediocre performance against all criteria. This characterization also largely matches this researcher's impression as a practitioner, and typifies why this model, so often implemented at an incredibly large scale, is so unsatisfying as an architectural and urban design solution.

Detailed review of panel responses to simulations in VPS™ sessions

Transit-located mixed-use parking structures: A transit hub – prototype 3.

In all panels, and in multiple settings, the transit hub received the highest overall scores.

Test 1: Ten existing built structures test.

The combination of parking and a recreation platform, seen in Case 6 at Colorado State University in Colorado Springs, Chart 4.8, scored first overall with a mean score of 6.34 raw and 3.81 weighted, on a 20-point scale (-10 to +10).

The focus of panel discussions around this model concerned placement and utility. When reviewed by individual criteria, the transit hub scored highest in Massing and Visual, and second for both Sizing and Scale. The Case 6 hub example scored a distant ninth for Placement, due to its rural remote location and it being the first structure to appear in a yet-to-be developed student housing cluster.

Test 2: Downtown infill simulation test.

In the downtown infill simulation model, the Transit hub, Prototype 3, Chart 4.9, scored first also when compared to five other approaches to parking. On an individual panel basis, the results were as follows:

Freestanding deck with recreation at roof and active ground floor - Prototype 3.

1. Lay panel: Highest score 6.61 raw / 5.14 weighted
2. Senior architects: Highest score 5.39 / 4.33 weighted
3. Millennial architects: Highest score 4.50 / 3.61 weighted
4. Public officials: Highest score 5.51 raw / 4.40 weighted
5. Mean of all groups: 5.50 raw and 4.37 weighted, based on the – 10 to +10-point scale.

When asked if the provision of the recreation element at a cost premium of 20% beyond the cost of a standard freestanding deck was acceptable, the favorable responses were as follows:

1. 80% for both the Lay and Senior architects' panels
2. 91% of Public officials
3. 100% for the Millennial architects' panel.

At 88% in the aggregate, this represents one of the strongest responses to any ancillary criteria. This number is the mean value for all focus group panels, the average of the scores appearing in the table above and as detailed in Appendix charts F-1 to F-3. An illustrative example follows in Chart 4.10.

C As a taxpayer would you accept a 20% increase in the cost of parking in order to build a recreation deck over a freestanding garage to extend its daily use and utility (20K vs 24K per space) ? (603)

Lay persons	Architects seniors	Architects Millennials	Board members	Mean of all groups
80.0%	80.0%	100.0%	90.9%	87.8%

Chart 4.12. Example of responses to binary survey conducted for each focus group.

This strong response was followed by preferences for: (a) access from minor streets (85%), and (b) inclusion of active fronts on all models (92% for the low-rise model, and 97% for the high-rise model).

The low-rise, wraparound, mixed-use residential option with integrated parking was the favorite for infill locations. As the second-most favored option overall, it scored well in both the downtown infill simulation as well as in the case examples. It scored first at the Metropark / Iselin regional transit site, and second overall at the Newark Broad Street Station transit site.

Test 2: Downtown infill simulation test.

See Chart 4.10. In the downtown infill simulation model, the mixed-use, low-rise prototype scored second when compared to five other approaches to parking. On an individual panel basis, the results were as follows.

Low-rise, wraparound residential - Prototype 4.

Wraparound residential mixed-use structure with active ground floor

1. Lay panel: Highest score 5.47 raw / 4.38 weighted
2. Senior architects: Highest score 5.47 / 4.38 weighted
3. Millennial architects: Highest score 4.44 / 3.56 weighted
4. Public officials: Highest score 3.92 raw / 3.17 weighted
5. Mean over all groups: 4.85 raw and 3.87 weighted, based on the - 10 to +10-point scale.

Test 3: Case studies – Three selected development sites.

See Chart 4.11. In the seven case examples consisting of various prototype and approaches to parking and development, the low-rise wraparound prototype seen in the Metropark Iselin transit site (Case 2A) scored first. The Newark transit site (Case 1A) scored second. On an individual panel basis, the results were as follows:

Example 2A - wraparound residential mixed-use structure with active ground floor

1. Lay panel: Highest score 8.33 raw / 6.30 weighted
2. Senior architects: Highest score 4.61 / 3.70 weighted
3. Millennial architects: Highest score 4.27 / 3.33 weighted
4. Public officials: Highest score 5.42 raw / 4.35 weighted
5. Mean over all groups: 5.66 raw / 4.42 weighted based on the -10 to +10-point scale.

When the discussion of visual treatments was tested, a metal and glass contemporary treatment outscored the more traditional stone and brick façade by a

considerable margin. All panel members remarked that the scale and mass of this contemporary approach respected the wide and narrow street base-heights and sky planes, although the margin of panel members who were accepting that the buildings exceeded the over-zone heights was marginally positive, with a mean of 66%. Support for that ranged as follows: 60% for the Lay and millennial panels; 73% for the Public official panel.

Third choice: Underground garage.

The underground parking option, Prototype 2, in the downtown simulation scored 3.50, see Chart 4.8. In anticipation of a favorable response, panel members were asked to address the high cost of building underground. When asked to respond to a 100% increase in cost in order to build parking below-grade ($20,000 versus $40,000 per space-unit), only 55% were in favor. As for an automated underground garage that could increase capacity two-fold at an additional increment of 50% ($40,000 versus $60,000 per space-unit), only 19.5% were in favor. All of the participants expressed familiarity with the relative costs of building structures of these types and their potential impact on the public purse.

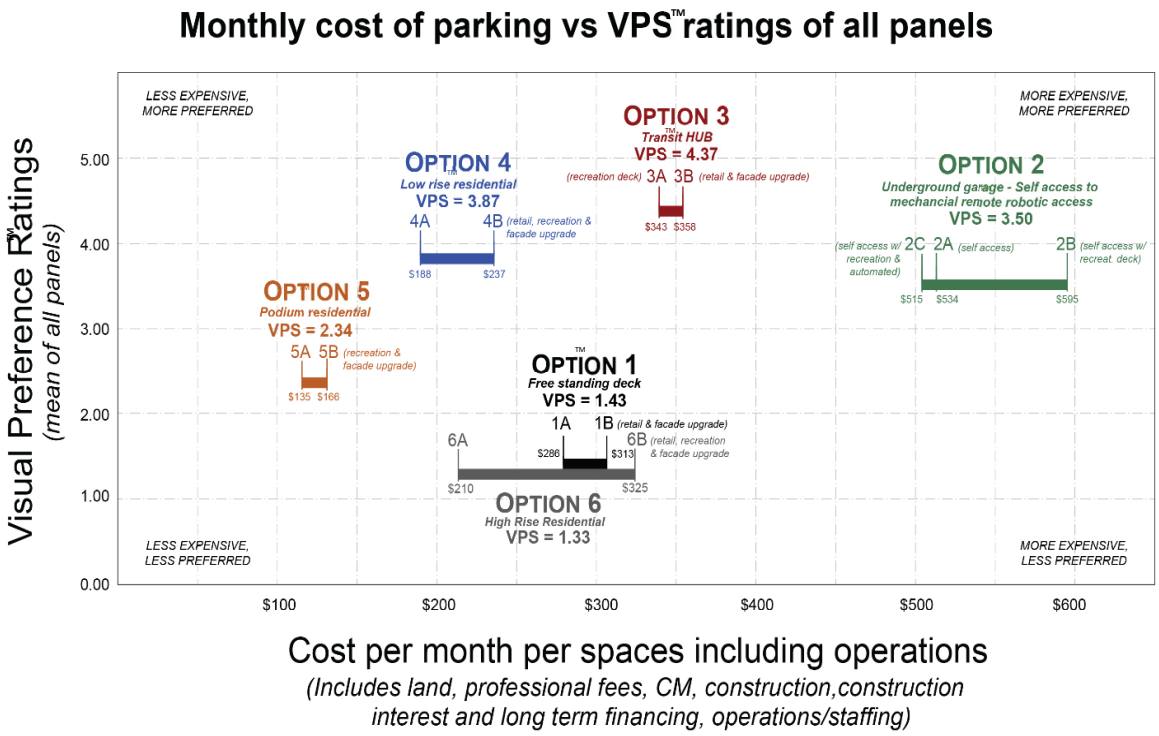
Best practice models

1. Transit hub
2. Low-rise wrap around residential with structured parking
3. Underground garage – Iterative prototype (see Appendix Exhibits C-5)

Upgrading parking is a minor cost in the larger cost of redevelopment

Narrative.

Demonstrating the direct relationship between VPS™ preferences and cost was a central outcome of this research effort. While cost is a known determinant in the selection of parking approaches, qualified user preferences are rarely incorporated in the decision-making process. Graph 4.1 and Appendix H-5, illustrates a clear correlation between panel preferences and costs in two stages: (a) the base costs on a per-month basis for the relevant option; and (b) the incremental cost increase to refit that base option with a series of upgrades.



Graph 4.1. Monthly cost of parking vs VPS™ ratings of all panels (see Appendices H1-H5).

Support for these optional upgrades is rated in the results of the binary survey. These preferences can be integrated into the schedule to fully detail the relationship between cost and these VPS™ derived ratings. The cross-referencing of data shows the actual costs of the top two preferred models: the Transit hub and the low-rise, wraparound, mixed-use, residential building, along with their various upgraded options available for an incremental increase in cost.

At the other end of the spectrum, the last options depicted are considerably lower in cost, but also received the lowest relative scores in the user preferences. These are the freestanding decks and podium residential structures that dominate the redevelopment market. The evidence for this lies in plain sight, namely lower cost, however. However, the corresponding low user enthusiasm for this approach argues for a different approach.

The pro forma models were built to test development returns and rents for the full series of prototypes depicted in these cases. These financial pro formas discern the actual breakpoints in land and infrastructure costs, unit density, parking requirements and ratios, and building height and amenity features. The correlations presented through this dissertation may lead to more integrated and relevant choices and implementations. This is especially important because, as an engineer engaged in redevelopment pointed out, ratios are often “developer driven...they desire to have a marketable project first, at whatever the cost, and only second to incorporate the benefits or location or transit access”.

This exercise aims to separate fact from fiction in terms of assessing the financial parameters that drive the development options illustrated, as well as in the seven scenarios representing typical approaches to these types of sites. The cost range for each option runs from a low of $178 to a high of $563 per month for the automated subgrade garage, excluding the cost of operations.

Three additional conclusions can be derived from this financial analysis

1. The cost of parking as a percentage of office and residential rents escalates quickly as the height and density of development climbs. In all cases, it ranges between 4.2% and 8.5% of monthly rents. When upgraded with enhancements addressed in the panel groups, it increases marginally to no more than 5.2% to 10.9%. On a per-space basis, parking represents less than 3.5% to 9.6% contribution to the overall cost of development, even when the upgrades are included. Note that in this comparison, the cost of façade upgrades applies to the entire mixed-use structure in the wrap around, podium, and high-rise models therefore inflating its value. .

   Additionally, the range of parking ratios incorporated impacts these figures, and are as follows: Low rise 1.65/unit, Mid-rise 1.20/ unit and High-rise 1.00/unit. Pie charts (Charts 4.13 and 4.14) show a clear picture of the breakout of all development costs of the base option and the upgraded option for all residential mixed-use prototypes, and their relative contribution to the total cost of development.

2. The cost of parking as a percentage of total cost of development can be controlled by focusing on parking ratios and on the generic approach to parking that is utilized, the details for which are shown in this dissertation effort.
3. Parking structures can be enhanced for a relatively small additional increment of cost over the base line cost of the structure.

These analyses consider first-cost and monthly income projections. As a member of the Public officials' panel pointed out, however, "Public entities are forced to look at total lifecycle costs, including costs of maintenance and periodic rehabs and reconditioning of structures such as these." This point of view is important, and in a potential area of future research maintenance can be factored into the analysis against the pro forma results to provide a sense of the relative value of initial versus lifetime costs.

Panel members were clear that while strong preferences may exist in terms of the form and approach to parking, the economics of implementation eventually becomes the determining factor.

Graph 4.1 provides a comparative with great utility in the development process

This comparison of ratings in the categories of VPS™ based preferences against cost levels demonstrates a method for weighing user preferences against the imperatives of cost.

The relationship of VPS™ scores to the monthly cost of each model in its several iterations is indicated in Graph 4.1. The vertical scale represents the weighted VPS™

value of all panels on a pooled basis. The horizontal scale indicates the range of costs for each alternative to each model. It also incorporates upgrades (retail bases, recreation decks, façade upgrades, and mechanical parking systems for the underground model).

Other panel responses to cost parameters assembled by direct survey

The issue of cost was further addressed with all panels in the form of several direct survey questions, responses to which included:

1. When asked whether they were in favor of public investment and expense to build parking for adjacent current owners of downtown properties, 77% of respondents were in support;
2. When asked whether they were in favor of public investment and expense to build parking for speculative investors in a downtown area, respondents overall had a neutral response of 50%, with Public officials opposing the largest margin scoring (27% favorable score);
3. When asked about potential investments in smartphone applications that locate spaces and increase utilization, 76% overall were in support. Millennials led at 90%, while Public officials expressed support at the lower end of the range at 64%;
4. Finally, when asked whether they were in favor of investing in additional capacity by eliminating downtown curb-side parking, the overall favorable response was only 45%. Support ranged from 10% from Lay panel members to 82% among Public officials. The Lay public objected to the loss of convenience where curb-side parking was eliminated.

Detailed review of financial models

A series of six development pro formas were created to represent the several prototypes models incorporated into the VPS™ simulations. The financial models address several generic forms of parking: (a) freestanding structures; (b) sub-grade garages; (c) freestanding structures located and fitted to act as a Transit Hub; (d) low-rise, wraparound, mixed-use residential buildings with multi-level structured parking; (e) mid-rise podium residential building with ground floor structured parking; and (f) high-rise, mixed-use residential buildings with multi-level mid-stack parking.

Assumptions and parameters of financial models

These models also tested for the following: the cost of land, related development, the projected costs of parking and unit monthly parking rents, and the costs of various upgrades and enhancements. The upgrades were based on a range of options discussed in the focus groups. Those options included:

1. The range of land costs based on placement;
2. Styles of parking: self-access versus tandem spaces;
3. Inclusion of active retail bases in the structures and offsetting impacts on rents; and
4. Other upgrades that include:
    a. Recreation decks included at top levels of structures
    b. Other amenity spaces included in program
    c. Enhancements to exterior façades/treatments

These models provide a range of outcomes for each of the generic building types studied and represent an overview of the economic implications for the choices profiled. They can also incorporate a range of targeted yields, returns, internal rates of return, and term lengths. These parameters are based on a similar set of economic criteria developed by Goldsmith in Bier et al. (2006). The results of this analysis are comparable to the models and projections presented in that overview.

For purposes of this analysis, all financial models incorporated the following:

1. 9% overall yield rate;
2. 20% equity requirement and a 12% preferred return to investors;
3. 30-year term on leverage at 5.5%; and
4. Presumption of a sale or exit at 7 years from commencement of operations at a uniform (CAP) rate of 5.5%.

This last criterion expands the analysis contained in the referenced *Parking Matters* (Bier, et. al., 2006) including a reversion factor for use in determining the ultimate valuation and internal rate of return (IRR) for the models. This approach provides a uniform basis for evaluating the ultimate value at the end of a seven-year operations/hold cycle, a normal timeline for most real estate funds and investment institutions.

The following charts represent the results of these pro forma comparisons, and a series of upgrades charted for each prototype examined. The graphics depict the complete costs, as well as the NNN monthly cost as equivalent rents for parking for each model shown (enlarged copies of these charts appear in the Appendix).

Charts 4.13 and 4.14 provide a full breakdown of the costs of development for each model and detail the components associated with parking and options for building and parking upgrades. The total value of the base option and its components, as well as the value of individual upgrades, is depicted in graphic and in numeric form. This information is provided for both freestanding prototypes and mixed-use buildings with structured parking. These outcomes are derived from detailed financial analysis of each prototype and its described upgrades. This information, as previously stated, is used as the basis for the comparative chart above (Graph 4.1), which provides the comparatives of VPS™ panel ratings against the economic costs of parking on a monthly basis.

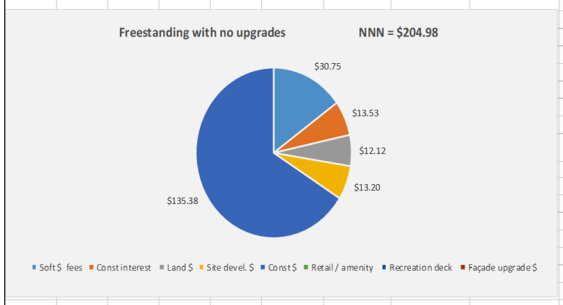
(The link provided to Appendix A gives access to the detailed excel models/pro formas used in this analysis and can be consulted for a deeper understanding for the basis of the financial analysis provided in this dissertation).

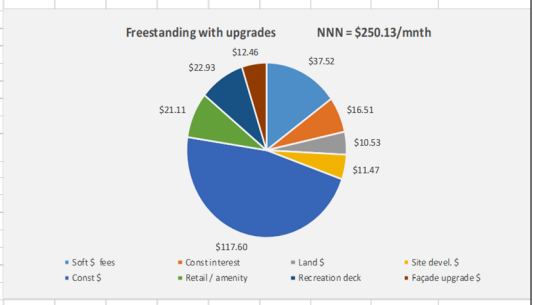
Freestanding with no upgrades							Cost ($mil)	NNN Monthly ($)
							$11.16	$204.98
Soft $	Const	Land $	Site	Const $	Retail /	Recreation	Façade	Automation $
$30.75	$13.53	$12.12	$13.20	$135.38				

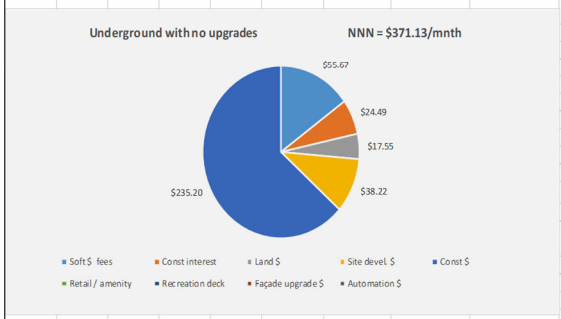
Underground garage with standard access, no upgrades							Cost ($mil)	NNN Monthly ($)
							$13.95	$371.13
fees	interest	Land $	devel. $	Const $	amenity	deck	upgrade $	Automation $
$55.67	$24.49	$17.55	$38.22	$235.20				

Freestanding with all upgrades except automation							Cost ($mil)	NNN Monthly ($)
							$15.67	$250.13
Soft $	Const	Land $	Site	Const $	Retail /	Recreation	Façade	Automation $
$37.52	$16.51	$10.53	$11.47	$117.60	$21.11	$22.93	$12.46	

Under ground garage with automated robotic system and recreation deck							Cost ($mil)	NNN Monthly ($)
							$26.54	$352.91
fees	interest	Land $	devel. $	Const $	amenity	deck	upgrade $	Automation $
$52.94	$23.29	$8.77	$38.22	$117.60		$23.89		$88.20







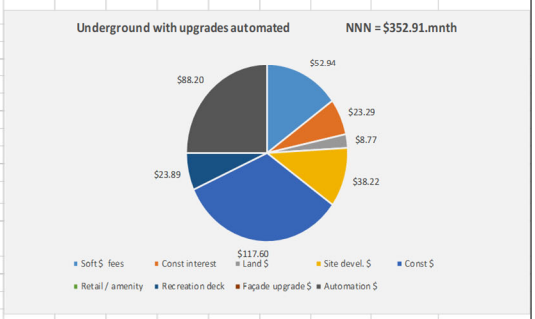
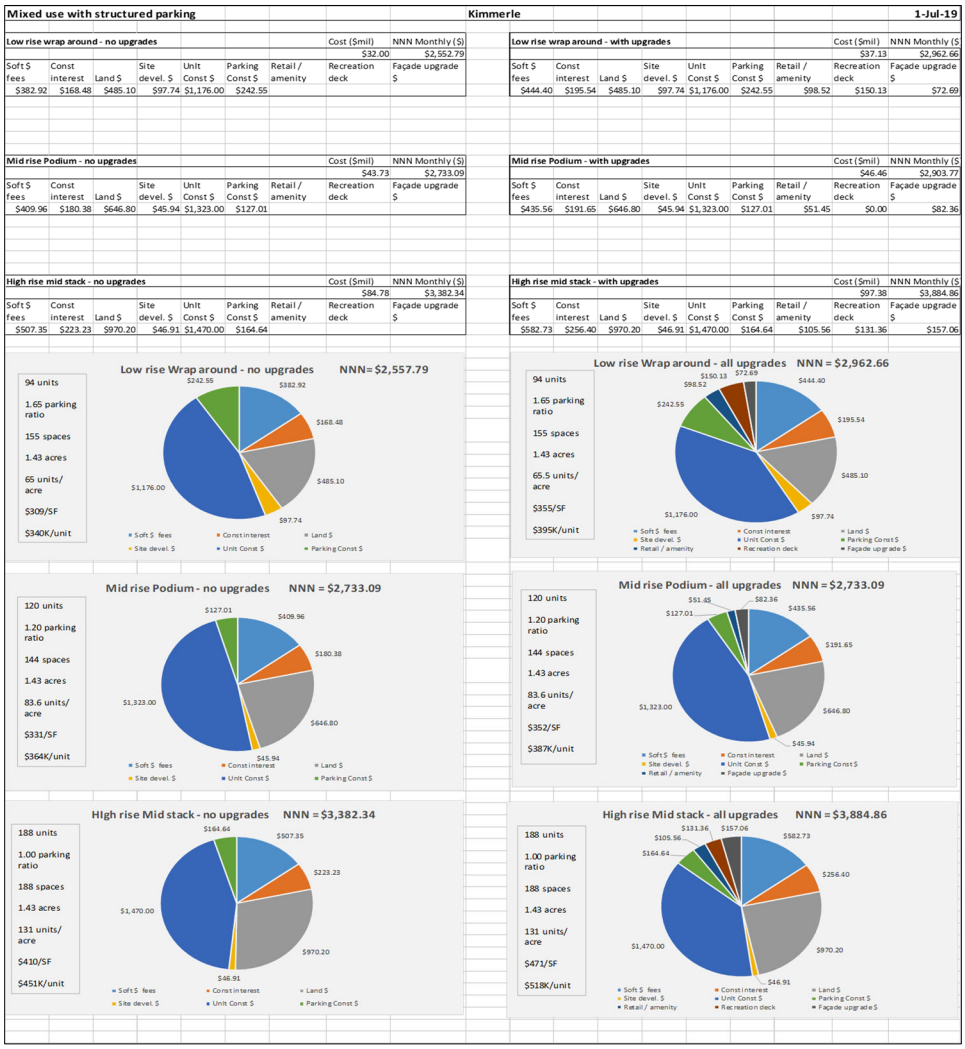


Chart 4.13. Freestanding structures and underground garage (base costs and upgrades)



Mixed use with structured parking — Kimmerle — 1-Jul-19

Low rise wrap around - no upgrades

Cost ($mil)	NNN Monthly ($)
$32.00	$2,552.79

Soft $ fees	Const interest	Land $	Site devel. $	Unit Const $	Parking Const $	Retail / amenity	Recreation deck	Façade upgrade $
$382.92	$168.48	$485.10	$97.74	$1,176.00	$242.55			

Low rise wrap around - with upgrades

Cost ($mil)	NNN Monthly ($
$37.13	$2,962.66

Soft $ fees	Const interest	Land $	Site devel. $	Unit Const $	Parking Const $	Retail / amenity	Recreation deck	Façade upgrade $
$444.40	$195.54	$485.10	$97.74	$1,176.00	$242.55	$98.52	$150.13	$72.69

Mid rise Podium - no upgrades

Cost ($mil)	NNN Monthly ($)
$43.73	$2,733.09

Soft $ fees	Const interest	Land $	Site devel. $	Unit Const $	Parking Const $	Retail / amenity	Recreation deck	Façade upgrade $
$409.96	$180.38	$646.80	$45.94	$1,323.00	$127.01			

Mid rise Podium - with upgrades

Cost ($mil)	NNN Monthly ($
$46.46	$2,903.77

Soft $ fees	Const interest	Land $	Site devel. $	Unit Const $	Parking Const $	Retail / amenity	Recreation deck	Façade upgrade $
$435.56	$191.65	$646.80	$45.94	$1,323.00	$127.01	$51.45	$0.00	$82.36

High rise mid stack - no upgrades

Cost ($mil)	NNN Monthly ($)
$84.78	$3,382.34

Soft $ fees	Const interest	Land $	Site devel. $	Unit Const $	Parking Const $	Retail / amenity	Recreation deck	Façade upgrade $
$507.35	$223.23	$970.20	$46.91	$1,470.00	$164.64			

High rise mid stack - with upgrades

Cost ($mil)	NNN Monthly ($
$97.38	$3,884.86

Soft $ fees	Const interest	Land $	Site devel. $	Unit Const $	Parking Const $	Retail / amenity	Recreation deck	Façade upgrade $
$582.73	$256.40	$970.20	$46.91	$1,470.00	$164.64	$105.56	$131.36	$157.06

Chart 4.14. Mixed-use residential structures with structured parking (base cost and upgrades).

Results for freestanding and underground structures.

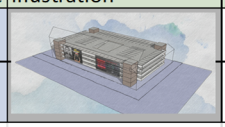
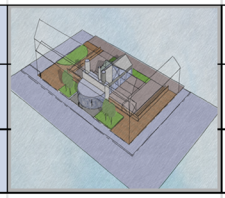
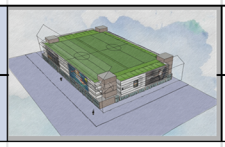
The small increment of cost required to create a more relevant mixed-use alternative to freestanding structures is detailed above. For instance, the difference between a deck—with or without a ground-floor retail component—amounts to an incremental cost increase of $27/month per space over a base cost of $286. This

represents an increase in monthly cost of less than 10%, an expense that is likely offset by the rental income associated with the retail use in place.

The details of those choices appear in the Table 4.2. The projected monthly cost of parking in a freestanding parking structure with no upgrades is $286/month/space. Upgrading this structure to include a retail element at grade, a recreation deck at the roof, and an upgraded façade raises that price to $313/month/space. This increase is minor because the income stream is positively affected by the retail rents associated with the first upgrade.

The projected monthly cost of an underground garage in contrast with no upgrades is $534/month per space, and if a recreation deck is included as an alternate that cost rises to $595/month per space. Further, should that underground deck incorporate an automated parking system, the cost decreases to $515/month/space based on the assumption that the total parking yield would double while costs of excavation and shell structure would remain unchanged.

For the transit hub prototype, the most favored model among the panels, monthly costs translate to $342/month/space, with the recreation deck and retail upgrades, and $358/month/space when an upgraded façade treatment is included**.** For the Transit hub design, the cost of a substantial façade upgrade represents a difference of only $16/month/space over a base cost of $345, only a 4.6% increase in the monthly cost of that deck option. The details of those choices appear in the Table 4.2.

A	Economics of parking decks				Jun-19
Alternate	Illustration	Prototype model	Land cost/space ($mil)	Number of total spaces	Monthly cost of parking per space
1A		Freestanding no upgrades	$1,790.63	470.00	$286.4
1B		Freestanding with retail** upgrade	$1,790.63	470.00	$313.3
2A		Underground garage	$3,546.10	282.00	$533.6
2B		Underground garage with recreation	$3,546.10	282.00	$594.8
2C		Underground garage with recreation and automation *	$1,492.19	564.00	$515.4
3A		Freestanding with retail** and recreation upgrade	$1,790.63	470.00	$342.57
3B		Freestanding with retail**, recreation and façade	$1,790.63	470.00	$358.46

* Assumes mechanical / automated systems will double capacity for same base costs of shell required.
** Value of retail rent has been excluded and is considered a wash for purposes of analysis

Table 4.2. Monthly cost of freestanding and underground parking decks

The results for the residential building prototypes .

The cost increment associated with the upgrade of parking in mixed-use settings is even less impactful. In the low-rise wraparound option, the total cost of parking is 8.5% of the average monthly rent for a one-bedroom unit at a ratio of 1.65 spaces per unit. The cost of single space per unit is under 5.5% of the monthly rent. When upgraded to include a retail component, a recreation deck, and a façade enhancement, the cost of parking per unit rises to 11% of monthly rents and only 6% on a per-space basis. In real numbers, that range of costs amounts to a spread of between $187.50 to $238.83 per space, representing a $51/space/month increase for these enhancements.

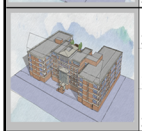
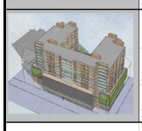
The parking ratios decrease in the mid-rise and high-rise alternatives, such that the increment of cost to achieve these enhancements falls to even lower percentages and value. The details of those differentials follow. The projected monthly cost of

parking for the low-rise residential building without upgrades is $309/month/1.65 spaces, which converts to a cost of $188/month for a single space in the structure. On a percentage basis, these figures correspond to 8.5% and 5.1% of the total monthly rent for an average one-bedroom unit. When the retail, recreation and façade upgrades are included, the monthly cost rises to $444/month/1.65 spaces, which converts to a cost of $391/month for a single space in the structure. On a percentage basis, these figures correspond respectively to 10.9% and 5.8% of the total monthly rent for an average one-bedroom unit.

The projected monthly cost of parking for the mid-rise podium building without upgrades is $162/month/1.20 spaces, which converts to a cost of $135/month for a single space in the structure. On a percentage basis, these figures correspond to 4.2% and 3.5% of the total monthly rent for an average one-bedroom unit. When the retail and façade upgrades are included, the monthly cost rises to $207/month/1.20 spaces, which converts to a cost of $166/month for a single space in the structure. On a percentage basis, these figures correspond respectively to 5.1% and 4.2% of the total monthly rent for an average one-bedroom unit.

The projected monthly cost of parking for the high-rise, mid-stack building without upgrades is $210/month/1.00 spaces. On a percentage basis, this figure corresponds to 4.7% of the total monthly rent for an average one-bedroom unit. When the retail, recreation and façade upgrades are included, the monthly cost rises to $325/month/space. This figure represents 6.5% of the total monthly rent for an average 1-bedroom unit, a 1.8% increase. Cost of parking and upgrades are allocated

on a per unit basis and so are proportioned to actual footprint of parking allocated per unit, which, in turn, varies by parking ratios adopted. Retail rents are not included in these calculations.

Economics of mixed use prototypes with structured parking					Jun-19		Upgrade cost per unit / month			Equalized costs	by ratio	Equalized costs	per space
Illustration	Alternate	Description	Land cost	Unit rent	Parking ratio	Monthly cost parking per unit	Amenity / retail space	Recreation deck upgrade	Façade upgrade	Parking cost per unit based on ratios allocated	Cost as a percentage of unit	Parking cost per single space	Sgl. space cost as a perc. of unit rent
	1	Parking excluded from rent - No upgrades	$75.00	$3,343.42	1.65	$0.00	$0.0	$0.0	$0.0	$0.00	0%	$0.00	0%
	2	Parking in rent - No upgrades	$75.00	$3,652.79	1.65	$309.38	$0.0	$0.0	$0.0	$309.38	8.47%	$187.50	5.13%
	3	Parking in rent - All upgrades	$75.00	$4,062.66	1.65	$309.38	$125.7	$191.5	$92.7	$443.65	10.92%	$236.83	5.83%
	2	Parking excluded from rent - No upgrades	$100.00	$3,671.09	1.20	$0.00	$0.0	$0.0	$0.0	$0.00	0%	$0.00	0%
	1	Parking in rent - No upgrades	$100.00	$3,833.09	1.20	$162.00	$0.0	$0.0	$0.0	$162.00	4.23%	$135.00	3.52%
	3	Parking in rent - All upgrades	$100.00	$4,003.77	1.20	$162.00	$65.6	$0.0	$105.0	$206.66	5.16%	$166.02	4.15%
	1	Parking excluded from rent - No upgrades	$150.00	$4,272.34	1.00	$0.00	$0.0	$0.0	$0.0	$0.00	0%	$0.00	0%
	2	Parking in rent - No upgrades	$150.00	$4,482.34	1.00	$210.00	$0.0	$0.0	$0.0	$210.00	4.69%	$210.00	4.69%
	3	Parking in rent - All upgrades	$150.00	$4,984.86	1.00	$210.00	$134.64	$167.55	$200.33	$324.62	6.51%	$324.62	6.51%

Note.	Allocation of upgrades		Low rise 1.65 ratio		Mid rise for 1.20 ratio		High rise for 1.0 ratio	Upgrade alloc.
	Based on applciable parking ratios		1100 +536 = 1,636	32.76%	1100 + 390 = 1,490	26.17%	1100 +325 = 1425.	22.81%
	Based on allocation for a single parking space			19.86%		21.81%		22.81%

Table 4.3. Monthly costs for mixed-use structure

The future state of mobility is uncertain, with one exception Narrative.

The panelists were asked to respond to questions related to the potential impact on structured parking of ongoing changes in demographics, habitation and settlement patterns, the automobile industry, and mobility.

Transit accessibility, innovations in rideshare, and autonomous jitneys— if they in fact prove to be a reality—do not diminish the panel members' focus on automobiles as their primary nor their perception of the automobile as the most reliable means of transportation. While an expected downsizing of demand and use for automobiles and parking is a hoped-for and welcome eventuality, panel members were skeptical about the eventual roll-out of these alternatives. They also questioned whether their

integration will in fact represent a sea-change in how communities and neighborhoods organize amongst themselves to address an alternate platform for mobility.

Detailed review of future state of mobility.

When asked whether they believed that parking demands would diminish over time due to the adoption of rideshare and autonomous vehicles, only 27% of the respondents agreed. A slightly higher percent (34%) believed that private vehicle use will be eliminated through the adoption of these alternates modes of mobility. This reaction may trace back to generational acclimation and/or a general lack of understanding of the timing and roll-out of autonomous systems. When asked if transit access positively impacted their impression of reduced parking, over 66% of respondents perceived a direct linkage.

Mobility and the need for parking are firmly established as a link in the participants' perceptions of commuting. The vast majority commute to work at least 3 days per week (85%), with a fraction using transit for even part of the week. Overall, they do believe that commuting to work will decline over time due to work-at-home and co-working offerings (69%), but only 25% currently work from home at least 3 days per week. The implications of these trends on parking and parking structures were clearly understood; however, an average of only 53% felt that these trends would reduce private vehicle use and with it the demand for parking.

Individually, the groups were split as to whether the adoption of rideshare and public transportation could result in the reduction or elimination of their personal vehicle ownership (20% for Lay participants, 50% for the Senior architects, 46% for

Public officials, and only 30% for Millennial architects). That is not to say that the downsizing of demand was not viewed as a positive or beneficial outcome, however panel members across the board adopted a pragmatic stance on these issues while scrutinizing how and in what ways these effects will impact their personal lifestyles. An engineer in one of the professional groups noted: “A pattern of decking 50% on-site, with the balance in open field lots,” the implication being that if demand downsizes, the open lots become available for future development.

This dovetails with a question as to what extent these parking structures should be positioned for reuse and adaptation. The choices advanced were very typical: housing and storage with manufacturing-based business incubators were perceived to be the most engaging. Viewing a model for the adaptation of parking to residential use contained in the protocol, most panel members responded positively, though their reactions were colored by the overall impression of changes in future mobility cited above.

Parking ratios.

Panel members were asked to react to reductions in parking ratios. As predominantly vehicle-dependent suburbanites, their personal ratio of vehicle ownership per household was above 2.44. This is higher than the ratio of 1.8 per family documented in Maciag’s (2017) article based on the U.S. Census American Community Survey (U.S. Census, 2011). This author noted that in 2016, approximately 5.2% of Americans worked from home and that for the first time this figure matches the percentage of workers commuting via public transportation, an interesting comparative.

It is important to note that while the percentage of workers working from home is on the rise, the percentage using public transportation is actually declining (Maciag, 2017).

Average vehicle ownership ratios in the selected counties surveyed in the New York and Philadelphia MSAs for this dissertation are currently 0.86 for urban counties and 1.50 for suburban counties. The result of the parking and demographic surveys conducted for this dissertation corroborates the panelists' responses to reduced sizing ratios. (Appendix G1 - G5)

1. The survey of a transit-located building in Hoboken revealed a ratio of 1.07 cars per unit, with one third (37%) provided on a stacked or tandem basis (see Appendix G5).
2. The survey of completed land use approvals in Morris and Essex counties revealed a direct relationship of parking ratios to transit proximity: 1.99 spaces per unit average for non-transit-located, and 1.54 spaces per unit for transit-located sites, representing a 28.5% reduction (see Appendix G3).
3. Parking ratios are diminishing and will further diminish over time as rideshare and autonomous vehicles are introduced; this is a fact that is yet to be fully established. See overview analysis in Appendix G1 for further survey work in this regard.

Based on these results, the ratios used in this study are justified: 0.8 parking spaces for a one-bedroom unit, and 1.2 parking spaces for a two-bedroom unit; 1.65 ratio overall for the low-rise model, 1.20 ratio overall for the mid-rise model, and 1.00 overall for the high-rise model.

Results validate methodology and traditional urban planning standards

Results validate methodology:

Narrative.

The methods review for this dissertation traced the multi-disciplinary nature of this research effort. A number of mixed-method techniques were employed from iterative design studies, to prototype development, VPS™ focus group testing, to detailed economic pro forma analysis and finally to direct survey techniques. All of these methods of analysis have been leveraged in the development not only the "Best Practice" design solutions but have also provided a substantial body of evidence to support the recommendations incorporated into those designs.

The methodology of this study centered upon five essential criteria—each a fundamental characteristic of a built object (or in this case, of a structure) that can be assessed from the point of view of performance and volume. This enabled the analysis and comparison of structures, which is essential to the iterative study and design of prototype models. It also enlarged the scope of traditional Visual Preference Survey™ techniques by asking focus group members to engage in analysis that goes well past a simple "like" or "dislike" assessment of paired images.

In this research effort, focus group members became deeply engaged in the process of understanding, assessing, and ranking a wide range of simulations and models, as well as responding to a related series of binary questions to confirm their preferences in a wide range of related subject areas.

Sources of individual research methods.

These iterative design approaches are derived from contemporary efforts in the world of "design thinking"—an area of research that stresses the use of traditional design processes and techniques to address larger issues with technological, digital, social, and cultural implications. Work at the University of California at Berkeley's Haas School of Business (Girard, 2017) is specifically focused at the integration of iterative processes into a wider world of research undertakings. The Berkeley Haas Innovation Lab's approach includes five modules: the design thinking mindset; observation, interviewing, and ethnographic research, making sense of qualitative research and generating insights, ideation and prototyping, and experimentation and storytelling" (p. 1).

The use of prototyping methodologies has long-standing roots in engineering and product design. The use of VPS™ techniques has a history of success in urban planning and social science settings. This dissertation also referenced abductive approaches to problem solving in cases such as these and the use of techniques that include comparative inference as a basis for analysis. In many of the approaches summarized above, comparative inference serves as the basis for analysis of one object or one feature from one iteration to another. Similar techniques have found traction in the areas of business, marketing, and brand identity. Specifically, Multi-Dimensional Preference (MD Pref) techniques seek similar findings, using vector analysis to ascertain and qualify qualitative and quantitative values for those studies. Much like this study, MD Pref integrates qualitative assessments and quantitative ratings with a traditional *t*-

test comparative analysis of variances between panel groups and their ratings and assessments

The mixed-methods approach that guided this dissertation proved to be essential in the exploration of this multi-faceted subject matter. The outcomes represented findings that are both qualitative and quantitative in character for a set of problems that are multi-dimensional and multi-faceted. The methods employed have demonstrated their potential in addressing similar questions in the area of evidence-based design, urban design, architecture and urban planning.

Detailed review of panel cross sections as a basis to explore inherent group biases.

The effectiveness of VPS™ techniques as a method for conducting inquiries into subject matters such as those explored in this dissertation are an additional area of inquiry noted in the Methods chapter for this dissertation. To demonstrate the effectiveness of these approaches, a detailed survey of respondents was also conducted during the course of the focus group sessions. Through this survey, a detailed cross section of each panel emerged and a larger understanding of the biases that each panel brought to the sessions. The descriptions drawn from the panel sessions responses to the post session survey, help inform on the issue of biases and how they are reflected in the results and ratings of the individual illustrations and simulations provided in the VPS™ sessions.

Composition of panels as revealed in the post panel surveys.

Organized as four panels of 10 members each, the groups were conducted over roughly a 6-week period from late April to early July in 2019. Panel members were

exposed to identical exhibits, simulations, and survey questions found in the VPS™ Exhibits (see Appendix J). Four separate panels were convened, which included Lay users of parking, Senior architects, Millennial architects, and Public officials. Participants can be characterized based on the survey conducted at the end of each session. Detailed charts convey the overall results and appear in Appendix F and are further described as below. Notably, these profiles were only obtainable by an exit survey of each panel member. Thus, they further inform on the character, content, and biases of the responses given by each group.

1. Though selected by areas of expertise, participants also tended to represent clustered age groups. The average age of panel participants was 48 years, with a range of ages from 23 to 74 years. Lay members averaged 46 years old, Senior architects 57 years old, Millennial architects 30 years old, and the Public official panel averaged 69 years old.
2. Overall, panel members were 34% female and 66% male. Lay members averaged 60% female, Senior architects were 100% male, Millennial architects were evenly divided between genders, and the Public official panel was 40% female.
3. 64% of all panel members were married. Fifty percent of Lay members, 56% of Senior architects, 50% of Millennial architects, and 90% of the Public official panel were married.

4. 39.5% had children at home. Lay members averaged 50%, Senior architects averaged 30%, Millennial architects averaged 20%, and the Public official panel averaged 56%.
5. Respondents consisted primarily of suburban dwellers, roughly split between single-family homes, and townhome or apartment dwellers.
6. All panels, including the Lay panel, largely consisted of those who currently hold—or recently held—management positions requiring them to exercise judgment or to advance generalized positions in matters critical to their work. That is to say, they are people familiar with the problems of collecting evidence and forming opinions based on those facts. The vast majority were college graduates, many with advanced degrees.
7. Family vehicle ownership averaged 2.44 vehicles; Lay members averaged 2.1, Senior architects averaged 1.9, Millennial architects averaged 2.6, and the Public official panel averaged 3.1.
8. All participants were familiar with parking and parking structures, and all currently owned private vehicles.

Participants offered mature and informed responses to the visualizations and questions. In almost every case, the results were found to be statistically significant. Additionally, a confidence level of 95% was achieved for all pooled results. In the analysis of individual panels an 85% confidence level was substantiated. Given the small sample size of these panels and the relatively abstract basis for the criteria used in the analysis, this 85% confidence level is justified.

Generational cohorts

In terms of generational distribution: the Senior architects and Public officials group consisted primarily of baby boomers; the Millennial architects ranged in ages from 23-38. The Generation X demographic was distributed across all panels (save for the Millennial group), with greater representation in the Lay user panel.

Characterizing the traits of generational cohorts is an imperfect science at best. It is a complex subject, as is any attempt to profile groups or demographics clearly. Tagging the panel responses to current accepted definitions of generational cohorts, however, serves to ground the study's results.

Identification of relevant biases

Qualifying any group biases that might impact results is essential to validating statistical findings. The following served in the identification of group biases and served to normalize the results:

1. Creating a common understanding across all participants by distributing concise definitions of the five key areas of interest prior to the session, and reviewing them again in the groups immediately prior to the evaluation;
2. Asking each respondent to rate the relative value of each of the five criteria;
3. Conducting statistical evaluations that tested for the reliability of the findings.

These steps, taken during the analysis phase, helped to normalize the results of each panel. These methods were effective in qualifying responses and creating comparatives of equivalent units so that the results can be contrasted and tabulated.

Several methods were used in the analysis phase to normalize the results from these intentionally diverse panels. An early first step in that process was to identify relevant biases in social science valuations: in-place, panel-based bias; generational bias; and situational bias.

Panel Bias

Panelists were asked to rank the importance of the five evaluation criteria, which enabled the creation of a weighted score for each group and the comparison of representative biases for each of the five criteria. Overall, the adjustments to weighted scores by panel were found to range within -3.54% to +2.46%, a 6.0% margin of the mean value; thus, these scores were accepted as equivalent overall. Individual criteria rankings varied to a larger degree within the mean, which conveys the panel differentials, biases, and personalities sought.

Statistical evaluations.

Two levels of statistical evaluations were conducted: the weighted values of all panel responses were pooled and reported first as group means, and then the tests were run again on a pooled basis for each individual criterion in consideration. In both instances, the results were significant, and they report consistently within a 95% confidence level. These results were validated for all simulations, cases, and survey questions and are therefore representative of equivalent population means for all responses.

Identifying a confidence level to demonstrate population values for responses, such as the ones obtained in this research, is a topic for discussion and debate. In the

medical field, it is not unusual to expect that tests for certain conditions only be assessed at lower confidence levels. The references in the Methods section of this dissertation to Colhoun and Gentner (2009) came from the context of medical research. In that work, similarities are modeled on results borne from comparative inferences which are an outgrowth of the abductive reasoning explored in the Methods section of this dissertation. In the field of social science, the utilization of confidence levels below the 95% range, to a 90% confidence level, is generally justified for small sample research of 100 responses or less, and in this instance that condition is present.

Generational bias.

A pertinent question is whether the responses are linked to a generational cohort. A test for generational bias or influence was conducted in two forms:

1. Panel members were asked to rank the five essential criteria, to enable the weighing of the VPS™ results on a relative basis;
2. The direct statistical testing of all responses to all questions in the form of a linear regression analysis.

The first series of tests showed the ranking of criteria by panel. The result suggests that there are very minor differences between the ranking of the five criteria when viewed from the perspective of panel membership.

		Total by panel with relative rankings of all five criteria (29 responses)								Mean of four panels		Differential to mean			
Group	Group	Lay(6)	Score/rank	Sr archt(6)	Score/rank	Mill archt(8)	Score/rank	Public off.(9)	Score/rank	Factor	Rank	Lay (6)	Sr archt (6)	Mil archt (8)	Public off.(9)
Sizing	Sizing	0.650	4	0.733	4	0.700	5	0.822	3	**0.726**	4	-11.75%	0.95%	-3.77%	11.66%
Scale	Scale	0.667	3	0.867	1	0.763	3	0.722	4	**0.755**	3	-13.18%	12.94%	1.05%	-4.47%
Massing	Massing	0.650	4	0.767	5	0.750	4	0.678	5	**0.711**	4	-9.40%	7.25%	5.19%	-4.92%
Visual	Visual	0.933	1	0.800	3	0.775	2	0.933	1	**0.860**	2	7.81%	-7.55%	-11.02%	7.81%
Placement	Placement	0.883	2	0.833	2	0.888	1	0.856	2	**0.865**	1	2.08%	-3.79%	2.54%	-1.10%
Mean	Mean	**0.757**		**0.800**		**0.775**		**0.802**		**0.783**		-3.54%	2.07%	-1.09%	2.34%

Table 4.4. Comparatives to an overall mean of all panels

The results indicate no more than otherwise in-place biases or preferences between the groups. These were anticipated, if not desired, and served as the basis for selection in deriving panel formats. In this case, the range from the mean of all is 5.88%, representing a substantial reduction between groups. The top two ranked criteria consisted of the same choices, Visual and Placement, with the exception of the Senior architects' panel, which ranked Scale, Visual, and Placement in that order. An interesting result, but not a significant outlier when viewed across the mean for all criteria selections.

A second analysis tracked these rankings by generational membership. When examined against the overall mean of all cohorts, the range of rankings is spread between -5.73% to + 2.64% or 8.35%. Across the range of all panels, Visual and Placement alternate as the first highest and second-highest ranked criteria.

Gen Z	2004	-		Gen Z		15
Millennial	1980	2003		Millennial	16	39
Gen X	1961	1979		Gen X	40	58
Boomer	1945	1960		Boomer	59	74
Silent	-	1944		Silent		75

	Total by group with relative rankings of all five criteria (26 responces)						Mean of three groups		Differential to mean		
Group	Mil (10)	Score / rank	Gen X (5)	Score / rank	Boomer (11)	Score / ran	Factor	Rank	Mil (10)	Gen X (5)	Boomer (11)
Sizing	0.690	5	0.720	4	0.691	3	**0.700**	4	-1.49%	2.74%	-1.36%
Scale	0.770	3	0.740	3	0.664	4	**0.725**	3	5.90%	2.09%	-9.18%
Massing	0.750	4	0.640	5	0.618	5	**0.669**	5	10.75%	-4.59%	-8.28%
Visual	0.790	2	0.860	2	0.836	1	**0.829**	2	-4.91%	3.63%	0.91%
Placement	0.880	1	0.920	1	0.764	2	**0.913**	1	-3.72%	0.79%	-19.52%
Mean	**0.776**		**0.776**		**0.715**		**0.756**		**2.64%**	**2.64%**	**-5.73%**

Table 4.5. Overview of generational cohorts and rankings of criteria

In an analysis based on the criteria rankings alone, both Generation X and millennial participants ranked Placement first and Visual second, while baby boomers ranked Visual first and Placement second. The balance of the criteria shares third, fourth, and fifth place in varying orders for all groups. The chart also shows the differential to the mean. While the Generation X and millennial cohorts share the same variation to the mean at 2.64%, the baby boomers ranged the other way by a wider margin of -5.73%, for a total spread of 8.37%.

Individual rankings that make up these means vary to larger degrees. The largest differential is the baby boomer assessment of Placement (-19.51%), and the millennial assessment of Massing (+10.75%). The majority of the millennials in this profile are young architects, so their appreciation of this criteria is likely heightened by recent educational exposure. Although it is tempting to extrapolate from these results, at this small sample size it is impossible to say that these responses are characteristic of generational values, or to say convincingly that millennials are somehow less visually oriented, or baby boomers more attuned to aesthetics overall.

The results were re-examined by generational cohort: baby boomers, Generation X, and millennials. The spread of ages to create these generational groups appears in the upper tables and corresponds to those adopted after extensive research by Darius Sollohub. Sollohub has performed a detailed review of this subject in his recent book, Millennials in Architecture Generations, Disruption, and the Legacy of a Profession (Sollohub, 2019). Sollohub's source is Strauss and Howe (1991), (who originated the term Millennials), as well as other sources including Pew Research. Strauss and Howe's

work in the field includes the cultural definitions and patterns that surround recurrent generational transitions (p. 8-18). In a study of a very similar nature, conducted in 1984 to analyze panel members' affinity for urban spaces and traditional townscapes, the researcher found that preferences clearly were associated with gender. This study conducted by Gilliam May Thompson of Middlesex University, Enfield, surveyed townscapes in English and Dutch cities, using VPS™ and MD Preference techniques. It concluded that correlations of responses ran with gender rather than age (Thompson, 1984, p. 414-417).

Situational biases.

In some responses, a single panel ranked a model or a simulation at a significant variance from the other three panels. In those instances, and in general terms, the adoption of an 85% confidence level resolved the disparities; this was not so in other cases. This may be attributed to the tests conducted. When responses of panels were pooled, the resulting means all tested at the 95% confidence level with significant responses. All variations were resolved. When responses were tested again on an individual panel basis, however, some responses fell to an 85% confidence level. This can be attributed to the small sample sizes and the nature of the framework which required panel members to respond not simply on a "like" or "dislike" basis, but at a finer level of detail utilizing the five criteria as the basis for their rankings.

Additionally, the open discussion format of these sessions did permit a certain amount of crosstalk which may have influenced some outcomes. For example, in the Senior architect panel, during the discussion of density in urban development, a panel

member referenced 1950s-era public housing to make his point. Analysis of the results later showed two models (mid-rise and high-rise) with variances that exceeded the norm of the other groups.

It is possible that the panelist's comment swayed the opinion of the wider group. It would be difficult to know without re-performing the panel. However, despite the inherent complexity of conducting open-format focus groups, the results obtained were significant and tested at an acceptable range of variance.

Results validate city planning parameters based on historic urban design standards

Narrative.

An important subtext of this dissertation is the role of urban design theory and city planning parameters in developing structured parking. This begins with Kevin Lynch's *Image of the City*, cited in the Literature Review. Lynch (1960) calls for an urban design theory that focuses on "the lack of understanding of the city image as a total field, of the interrelationship of elements, patterns and sequences…in a composed and connected whole," taking into consideration all elements of the city space, not simply buildings and streets (p. 158).

Further, the specific design parameters that Barnett (2003) addresses in *Redesigning Cities* were central to the development of prototypes, simulations, and cases used in the panel reviews and the VPS™. The results serve as an endorsement of Barnett's recommendations—either by direct attribution, or by inference from the rankings and ratings of the selected cases, most notably in terms of:

1. Creating urban environments that are walkable and transit-connected;

2. The use of base-height, setback, and sky-plane regulations, as opposed to floor area ratios, in determining mass and height;
3. The continuity of the street wall, mixed-use structures, and, most notably, active retail frontages that engage with the street space;
4. The incorporation of elements of Smart Growth in the creation of neighborhood and district delineations and standards (referring Duany/Plater-Zyberk's transect system);
5. Integrating natural landscapes, contours, and vistas into street planning exercises, and taking environmentally driven approaches to shelter and shading (Barnett, 2003, p. 247-273).

Barnett's criteria are also evidenced in the New Urbanist codes, which are currently being translated into form-based municipal codes.

Detailed review of panel responses

(See Appendices F-1 through F-3 for a complete narrative)

Panel responses to redevelopment and parking guidelines were based on a series of questions directed at related policy issues. Controversy surrounds the allocation of parking in downtown infill settings at it relates to building or overbuilding public parking for current or future demand. The question is whether parking should be built at public expense to address current demand and congestion, or if towns should build to address future proposed development projects—whether through current zoning or planned redevelopment zone allocations. A former housing authority executive director from a

major Hudson County city remarked that “TOD platforms, density platform and policy, and critical mass planning” all deserve serious scrutiny.

The question is further complicated by the fact that public policy decision-makers draw a distinction between long-time holders of those properties versus new acquisitions or assemblages by outside development interests. This question was put directly to respondents in the course of reviewing the downtown simulation. The findings were as follows. The majority (73%) agreed with the notion of erecting parking for existing demand and property owners (Binary Question 101). A smaller majority (62%) felt that parking erected for redevelopment by outside parties should also be a responsibility of the public parking entity (Binary Question 102). Interestingly, the Public official panel, whose members are very familiar with the politics of this, roundly rejected the latter position of building parking for new development interest.

The issues of height and scale were addressed in both the depiction of major and minor street setbacks and of height envelopes in the downtown simulation, and also reviewed in a series of direct questions. All groups appreciated the use of the base-height and sky-plane device in the downtown simulations but did not feel particularly constrained by these urban design and zoning controls. When asked whether structures in the zone could exceed these constraints, 70% of the respondents agreed (see also Binary Questions 206, 207, and 208).

The notion of building parking to address open space, and the redeployment of the public street space, as well as the full or partial elimination of on-street parking (the planner’s panacea), were addressed in a series of direct questions. Surprisingly, a

majority of the panel members were against deploying structured parking for this purpose (70%). A significant number of participants decried a loss of convenience from a reduction in curbside parking access—and not only for shoppers. A Senior architect pointed out, “It serves different needs. To take the parking off the street, is ideal for walking shops; but if you’re the merchant trying to stock that shop, you’re screwed. You have nowhere to load” (Binary Question 604). When the discussion was broadened to address the demands for curbside rideshare and autonomous vehicle pick-ups and drops-offs, the protest was only mildly suppressed (Binary question 104). Overall, participants expressed a preference for parking access from minor streets or alleys, and active ground floors across the board; this was the case in both the VPS™ and in the discussions. Binary Questions 401, 201, and 202 address these issues directly.

Overview of guideline and implementation strategies for structured parking

(See Appendices D-1 and D-2 for a complete narrative)

The summary presents these items in synopsis form for sake of brevity. A detailed summary of these recommendations appears in the Appendix Section D. The recommendations adhere to the outcomes and conclusions contained in this chapter and are drawn by reference from the literature including Barnett(2003) and Lynch(1960) and the several areas of interest cited throughout this text.

Strategies for implementation / Rules of the road

Rule 1. Low scale is consistently desirable. A low-rise mixed-use wrap around model conceived in this dissertation is a good representative model. See Best Practice Model – Appendices C-2 through C4.

Rule 2. Mid-rise podium structures are perhaps the most ubiquitous of all of the building forms investigated. These massive intrusions simply up end traditional neighborhoods whose scale and delicate nature is being overrun by these buildings.

Rule 3. If super density is a must, high-rise buildings of 8-40 stories or more that integrate parking at a mid-stack height allows the building to maintain an activated street front while segregating parking away from pedestrian zones.

Rule 4. Sub-grade garages in important and central urban spaces is the panacea of parking alternatives. Finding methods to mediate several of the larger cost components of underground garages, mechanical venting and structural costs are a must. Of all the forms of parking, underground structures require a serious investment of engineering and design talent to find viable future solutions to this underused building form. See Best Practice Model – Appendix C-5.

Rule 5. The urban or suburban transportation hub as a model is something that aligns with regional planning and Smart Growth goals. Integrating rail (if available but not a necessity), bus malls, autonomous and rideshare pick-up and drop zones, bicycle and scooter storage and a variety of community-based uses including recreation fields are going to be a mode of the future that extend the utility of these structures all day and week-long. See Best

Practice Model – Appendix C-1.

Rule 6. Sharing to offset parking demand can be done in several forms.

Strategy 1. Local zoning is adopting parking sharing formulas that stress bundled peak use for a variety of mixed-uses.

Strategy 2. Publicly built parking reservoirs. Local publicly and operated parking facilities exist, projected capacity can be allocated to that public facility at a prescribed ratio. Future demand or reductions can be offloaded to this location to allow reassignment without disruption to the built neighborhood in which it is located.

Rule 7. Planned conversion of new parking to alternate uses is a must. Anticipating change is a priority for any structure built today considering its likely 30-40 years of useful life .

Rule 8. Placement in the street scape matters.

a. Begin with siting structures in alignment with street walls with an active lower floor of retail and potential office uses at the upper floors.

b. Over time, the ground floor of parking structures will convert to autonomous rideshare depots with intense pick-up and drop-off zones.

c. Control curb cuts. Preferably place access and egress points at

the adjoining minor streets.

d. Conform to basic base-height and setback parameters that limit frontages to maximum heights depending on the size and scale of the adjacent frontage.

e. Parking is inherently unsustainable as a building type, but that does not mean that there aren't means available to limit its carbon footprint including green elements.

f. Safety first. Parking environments are still considered by many as threatening and unsafe zones. Visibility in entry and egress zones, as well as transparent stairs and corridors, are paramount.

g. Over time, pick-up and drop-off zones will predominate and must be integrated into the city space.

Rule 9. Parking integrated with associated mixed uses, varying scales and densities along with a variety of transportation and mobility options represents best practice.

Rule 10. Design matters. There are numerous models including Best Practice models and prototypes developed for this study along with a wellspring of sources and methods to help design parking as a meaningful component of an urban plan.

Summary

Potential future applications of this building form include possible landmark and

gateway experiences, and the creation of truly integrated intermodal transportation zones in every city and town. The adoption of new evolving technologies, including but not limited to autonomous vehicles, rideshare applications, automated and mechanical self-directed stacking systems, are transitioning these building forms to alternate uses.

Perhaps they can transform even further than scholarly imaginations have heretofore envisioned. However, if they fail to do so, then that failure lies in the inability to conceive of a future space where these buildings—these massive investments in public and private infrastructure—have a relevant role to contribute to the creation of a modern, urbanized and a culturally rich quality of life.

Six guidelines

Dimensional constraints for infill building and parking structures are applicable to all building prototypes presented in this text.

Sizing. Sizing is determined by demand. Demand as projected results in requirements that determine current and future capacity (more likely consisting of a downsized demand over time).

1. Encourage shared parking with adjacent and complementary uses to determine utilization and capacity required.
2. Review local authority capacity and resources to determine if offloading demand at certain times of the day is feasible. The reservoir of parking within walking distance should be looked at as a shared resource that can be distributed and redistributed on an as-needed basis.
3. Size parking structures according to a percentage of peak hour demand

in lieu of full peak projections. Consider all parking within walking distance when making this assessment.

4. Managing parking is fundamental to appropriate sizing. Ensuring that it is always used at its maximum utilization or occupancy minimizes overbuilding. Inventory applications and other devices that locate and acknowledge parkers of an available space via roadside information screens or phone applications are an inexpensive way to assure near 100% occupancy at peak hour.
5. Recognizing the need for transit in multiple forms is a must. Replacing parking through the use of multiple forms of transit, rideshare, autonomous jitneys (when available), scooters and bicycling, and walking can lead to downsized parking demand.
6. Incorporating emerging cultural, demographic patterns (including live/work, work from home, and freelance employment) eliminates and reduces the need for parking.
7. Parking ratios derived from another era should be discarded and recomposed for a local context, modern setting, and utility. Use of maximum allowable ratios limits the size of parking lots. Encouraging mixed-use applications and development scenarios that use these maxims thereby minimizes the costs of built infrastructure and the destructive effects of a car-centered, anti-urban, and anti-street life posture.

8. More intense and efficient use of parking can include tandem spaces, long and short-term vehicle stacking, and valet programs. 24/7 access to self-park vehicles is no longer a must, so these alternatives help minimize footprint while maintaining capacity.

Scale. Building height and length are visually crucial and of utmost importance to any building's placement and integration into its setting. Determine an applicable bulk by surveying adjacent and contiguous properties and those in proximity to a proposed site for parking structures.

1. In a suburban downtown or an urban narrow street, the base-height should not exceed four residential stories (36-feet) or three commercial floors (36-feet)
2. In an urban zone or a wide suburban street, the base-height should be equivalent to six residential stories (55-feet) or five office commercial floors (60-feet).
3. Stories above this base-height should set back at a sky plane that is no less than a 30-degree angle with a five-foot elevation as the base point. Setbacks and their visibility are matters of perception and study and can vary.

These determinations are context driven, but every setting has an appropriate standard that can be determined by survey and recording the scale of adjacent structures.

Massing.

1. Building mass for a new freestanding parking structure should be limited to no more than a 200-square foot footprint, or a 40,000-square foot floor plate, with an associated 95 parking spaces for any single level of the complex.
2. If the size of the structure is larger, then it should consist of a number of similarly sized elements at these dimensions, composed in modulated, offset forms. Utilizing this massing guideline can assure that the overall mass and scale of a structure remains within a street-scaled dimension.
3. These dimensional constraints also assure a module of approximately one third of a block within a standard city street grid, which averages 200-feet to 250-feet by 700-feet per block in most American cities. (See diagrams at end of this section for the relationship of basic parking modules to block and street dimensions)
4. Breaking down the massing of any building is always appropriate but can be problematic for parking which relies on regular and consistent floor plates. The diagrams furnished and cited in the Appendix help to illustrate the relationship of parking footprints to standard city blocks, where dimensions become important to the parking structure's ultimate efficiency and utility.
5. Whenever possible stair and elevator towers at junctures of these basic

building blocks should be used to offset heights and setbacks, and to distinguish one element from another.

6. Wherever possible, use building wrappers or liners of residential, office and retail use to encase parking.
7. To plan for future conversion, offset the face of parking by a setback of 30-feet to 40-feet from the street or property line (the average depth of a single loaded apartment block) to allow for residential infill. See Appendix for models that illustrate methods to implement this conversion.

Visual. Screen parking floors or levels along all pedestrian fronts through a variety of approaches.

1. Mixed uses integrated into parking, especially at ground floor frontages
2. Match adjacent architecture and modulate the form to provide regular and incremental massing (i.e., reflective of individual store or building fronts in a traditional street setting).
3. Decorative architectural elements should be selected for their appropriateness to adjacent buildings and forms. Screening materials should evoke interest, with lighting and coloration appropriate to their settings.
4. Digital or billboard effects and displays can be active and engaging and focused at the street space. These approaches are particularly appropriate for downtown buildings in public places, or for parking

decks along highway settings were digital advertising is normal and appropriate.

5. Green facades that include a variety of design and planting programs are effective as well.

Placement in the street space. Two generic choices exist: the first is a location in the center of activity, and the second is a location accessible by foot or by transit or jitney, but outside of the confines of public view and impact.

1. Preferred locations include: central city sites, especially at public squares and plazas, requiring minimal impact and complete discretion; sub-grade garaged structures, despite the extreme cost, have a role to play in this context, as underground garages preserve open public spaces while providing accessible parking at prime points in the city; care must be taken in siting entry and egress points of vehicles, pedestrians, and access for transit, bus, jitney, and rideshare. See Best Practice model – Appendix C-5 for alternate approaches to underground parking.
2. Remote structures require shuttle and jitney links to specific locations. As rideshare and autonomous fleet vehicle systems gain traction, remote structured parking should become an important focus of public investment.
3. Parking structures must be integrated into the street scape.
    a. Front facades and street liners must be provided along the public

realm, and should be located at the ground floor with an active retail or other street-focused use. That liner should extend the full width of the front façade, excluding points of access and egress

b. Points of access, egress, and driveway aisles should preferably occur at the side streets, but if occurring at the frontage they should be bundled to minimize the number and size of curb cuts which disrupt pedestrian movement and safety.

c. Parking levels at the street line should be flat plate with all ramping or pitched floors running away from the street, and not obvious from the frontage. This provides a normal and regular series of building elements that can be overlaid with appropriate exterior treatments and avoids a gymnastic visual effect of the building structure from the ground plane.

d. Being alert to opportunities to frame local landmarks and important points of juncture in a street system is also important.

The parking structure as a Transit hub and mobility transfer zone

Understanding the larger role these structures can play requires a consideration of the traditional role of major port, ferry, and train terminals in the city. The hub should be regarded as a gateway to the city and an integrator of multiple modes of mobility, along with its role as a public space in and of itself. To this extent, including public concourses, public uses, and recreation and retail uses within the structure itself helps define a parking structure as a point of entry,

embarkation and greeting to the civic space. This is an opportunity that should be sought and constitutes a redefinition of parking that should be embraced when planning and designing future transit hubs.

Summary, key points, guidelines

1. Determining the size and scale of a parking amenity in any proposal is a process of negotiation with local town officials, zoning standards, and user demand.
2. Beyond code requirements, the perception of market demand affects absorption, rental rates and economics of the development for the intended user. This is largely a marketing and economic question as opposed to a regulatory issue as depicted in 1 above.
3. Public parking access is used as a genuine lever in controlling or limiting development activity. Control of volume of community building is a political act and based on a community perception of what is tolerable.
4. The ultimate scale and massing of these structures is a direct offshoot of the factors above and the relative densities being sought in the redevelopment proposal. Of late, super densities in excess of 65-75 units per acre, and even as high as 125 units per acre, are being sought in many urban, suburban and exurban clusters. These densities will require new design and planning approaches.
5. The visual treatments of these buildings are directly related to the style and scale of the context and of the office, retail, and residential

structures that accompany these parking structures. As super scaled developments emerge, an entirely new context is being proposed, to which these structures must yield to in their style, definition, and overall aesthetics.

NOTES TO FINDINGS CHAPTER

How best practice model examples advance findings of this dissertation and embrace implementation strategies, standards and guidelines and public policy agenda.

Detailed architectural and site development studies for these best practice models appear in the Dropbox link in Appendix B, and accompany the colored renderings appearing in Appendix C and in this Findings chapter.

Note 1: Best practice model - Transit hub at local train station.

Appendix C-1

Components.

- Parking. Self-park, valet and long term stacked spaces provided.
- Drop-off and pick-up zones for bus, taxi, jitney and autonomous systems.
- Integrated retail, police and post office units.
- Affordable housing element freestanding on site and adjacent to HUB center.
- Integrated recreation deck, bleachers and public gathering space/atrium. In this case, the atrium follows the recreation theme and is a local sports Hall of Fame.

Criteria addressed.

Sizing. Two decks of two and three parking levels, 96 spaces per level, for a total 480-space capacity. Decks also act as a central parking reservoir for an adjacent downtown redevelopment zone.

Scale. Modules do not exceed three stories nor an individual 180-foot by 220-foot footprint.

Massing. Stairs are articulated, as are individual program spaces and architectural elements. Featured as well is a three-story atrium connector. A public space is positioned between each parking element.

Visual. Contemporary metal and glass atrium connector with traditional brick facade and concrete frame at parking levels. Both elements meet VPS™ panel preferences for freestanding decks.

Placement. Sited at local transit station, adjacent to downtown area; located in proximity to elementary school and local ball fields; acts as parking element for recreation fields during nights and weekends.

Access points for vehicles are located away from pedestrian paths and links to trains and bus mall. Bicycle storage and jitney access are located at the open plaza between the train station and the parking decks.

Public policy. Provides a means for shared parking in a downtown setting. Parking is shared between requirements for transit, needs of adjacent downtown redevelopment zone, and the off-hour utilization represented by the recreation elements incorporated into the plan.

Transit hub acts as a connector and extender of regional transit via rail, bus, rideshare, and autonomous jitney interface at this site.

Note 2: Best practice model - Low-rise mixed-use residential building.

Appendices C-2, C-3, C-4

Components.

- Consists of 4-story, 96-unit housing element with residential units arranged around a central landscaped enclosed courtyard.
- Courtyard is the top level of a two-level parking structure. This is a wraparound approach with two levels of the residential element consisting of single loaded floors. Above the parking deck structure, double loaded residential floors occur for the balance of the building height, some fronting on the interior enclosed landscaped courtyard.

- Ground floor retail building with co-work office spaces at floor two occurs at frontage opposite freestanding bus / jitney mall which provides links to area transit connectors and local attractions.

Criteria addressed.

Sizing. Two 96-space parking levels with self-park and tandem spaces at an 80/20% ratio, 192 spaces total. 158 residential spaces provide a parking ratio of 1.65 spaces per unit average. Balance of 34 spaces are devoted to office and retail users at a ratio of 2.25spaces per 1000-square feet for a 15,000-square foot requirement.

Scale. Four story, 45-foot height meets most requirements for downtown infill residential zones. Frontage consists of a two-story 24-foot tall commercial structure built at the street line. Ground floor elevation steps away from street to provide covered outdoor seating areas adjacent to retail users at that level. Options to increase height to five or six stories at rear wing in an infill setting is illustrated in the photo montage provided.

Massing. Residential and commercial elements are articulated with stair and elevator cores featured. Individual balcony elements at residential units are protruding to provide variety and detail to building facade.

Visual. Metal and glass facade elements of dark grey and white colors provide contemporary aesthetic and matches VPS™ panel preferences. Commercial element is a glass and metal structure topped with an open-air green space. Alternate for a traditional brick and stone facade

appears in the simulations and is another and second ranked treatment for this mixed-use building type.

Placement. Located on a primary street this full block depth footprint provides direct pedestrian access from the frontage and side streets. Vehicle access is from rear alley off of side streets or an alternate centralized single curb cut at the building frontage.

Public policy. Integration of mixed uses and parking in an infill setting. Shared parking arrangement between residential and commercial uses with direct access to surface transit accommodations.

Low scale infill housing solution with features and amenities that appeals a wide-ranging demographic from singles, to young families, to seniors looking to relocate to a more densified urban setting.

Note 3: Best practice model - Underground garage on campus.

Appendix C-5

Components.

- Consist of three 105-space parking levels positioned below grade. Self-park and tandem spaces are provided.
- Deck is a traditional steel and concrete structure and occurs at the lowest level of an excavated well or recess carved into a rising 30-foot grade differential on an open landscaped college or office campus.
- Side walls of the well are unit block or rammed earth construction with a green landscaped feature overlaid. Sufficient open ventilated space is provided between well walls and structure to qualify this structure as a self-ventilating deck, eliminating the need for mechanical ventilation.
- Optional landscape / recreation deck and air supported enclosed shell or bubble occurs at the top deck depending on its location and utility.

Criteria addressed.

Sizing. 315 spaces over three levels in a 200-foot square footprint. Excavation is 30-feet deep but can be a combination of a fully or partially buried perimeter. This deck acts as a parking structure and shared reservoir for adjacent structures on campus.

Scale. Low impact by nature. The below grade deck in this instance is out of line of sight. At 330 spaces, it is also small enough to represent a non-threatening and non-intrusive presence on site.

Massing. Only articulated elements are stairs and perimeter rail treatments and safety elements at perimeter of the open well. Scale of open or enclosed recreation shell is relative to other on campus structures.

Visual. Aesthetic is minimalistic and out of sight. Encased in green feature walls at interior faces, the deck provides a sustainable alternative aesthetic for parking design.

Placement. Located adjacent to main campus arteries. This parking element is adjacent to on campus uses and provides pedestrian, bicycle and vehicle access from a series of ramps that drop into the first level of this below grade structure.

Public policy. A means to integrate underground parking at a lower cost in a variety of settings from downtown to on campus. A means to integrate a low-tech, low-cost alternative for the VPS™ and publicly favored alternative.

Optional integration of recreation feature means land area devoted to parking can have a public benefit in recreation and open space programs.

CHAPTER 5. CONCLUSIONS, IMPLICATIONS, AND FUTURE AREAS OF RESEARCH

Structured parking is both an early and determining element in development and redevelopment efforts. At their best, parking structures have the potential to become integrated elements of public infrastructure that can incorporate mixed and public uses, provide recreation and other services, and complement urban downtown areas and family and resident-focused neighborhoods.

This dissertation contends that it is possible to improve the design and implementation of structured parking in a variety of settings by concentrating on five principal design criteria common to all building types: (a) sizing, (b) scale, (c) massing, (d) visual presentation, and (e) placement. These criteria impact many aspects of a redevelopment's final result, including its total development density; parameters for adjacent buildings and open space; pedestrian visibility, safety, and movement; visual style; and quality. This dissertation also considers the impact of ongoing demographic shifts and technological innovations on vehicle ownership and usage, and the potential reduction in demand for structured parking that they portend.

In pursuing these two areas of inquiry, this dissertation applies and integrates multiple research methods: iterative design processes, criteria testing, and prototyping; Visual Preference Surveys™ that use graphic and model simulations; focus group sessions and interviews with subject matter experts; and survey techniques and analysis of census data and other databases. It also assesses and analyzes the development cost of the various prototype models, including rental implications.

Implications

Highest-ranked prototypes present a greater role for structured parking

The current survey respondents conclusively preferred three prototype models. Collectively, as stated in the Introduction to this dissertation, they represent the primary ways in which structured parking can serve its context and users more fully.

Transit Hub

Low-rise, mixed-use

Underground on campus

Figure 5.1. Best practice model of suburban transit hub.
Figure 5.2. Best practice model of low-rise residential, mixed-use building.
Figure 5.3. Best practice model of underground parking in an on-campus setting.

All models incorporate appropriate scale, massing, and visual treatments in order to contribute positively to the overall quality and aesthetic of the urban spaces surrounding them. All three also offer an engaging, navigable, safe, and secure experience for pedestrians. The transit hub features both transit integration and mixed public uses, including recreation, and also shows how structured parking can provide a welcoming gateway to a community. The low-rise residential, mixed-use building offers ground-floor retail spaces that provide meaningful connections to the street and public realm. Further, the model unites multiple forms of mobility, integrating both a bus transit mall and concealed structured parking. The underground prototype incorporates

a recreational element for an entire campus community and is based on a structural and mechanical solution that reduces development costs.

The three prototypes embody core urban design and planning tenets

The best practice models for this dissertation, as well as the implementation strategies drawn from them, reflect recommended standards for sizing, scale, massing, visual presentation, and placement found in the body of literature of architectural and urban design theory. More than that, the consistent results of the VPS™ provide a second level of validation for these standards among laypeople, professionals, and public officials, with one exception noted – specific discord was evidenced in choices for visual representation for freestanding structures and the mixed-use low-rise prototype.

All three prototypes successfully treat structured parking as a part of a wider system: the city space as a linked and integrated "whole" (Barnett, 2003; Lynch, 1960). This dissertation drew on these authors' work as key sources for urban design and planning standards. The prototypes are appropriately scaled with respect to their contexts and to structures adjacent to them. Secondly, their treatment has been thoughtfully considered and presented with an eye towards representations that engage at a human scale. This suggests that an array of fenestration or façade elements—such as individual details at entries and other openings—perform well at the scale of the street and the public place where these structures have been placed or to which they are oriented. The prototypes also show how to approach other aspects of parking structure design, including the orientation of ramps (i.e., away from public view, or internalized within the form, as a triple-bay parking layout allows). They also show

successful placement of entry points for both pedestrians and vehicles, as well as drop-off zones. Such considerations are not only a function of safety, but also offer a means to control these flows and to mitigate congestion and impacts on adjacent streets. Poorly controlled, all of these factors can have negative effects on pedestrian and bicycling zones.

Respondents largely favor traditional treatments for freestanding structures in downtown or urban contexts. This was the one area of disagreement between focus group members, as well as among some sources in urban design and planning literature—putting aside New Urbanist dictum for overall building treatments. For panelists, contemporary façade treatments are acceptable but only in the mixed-use structures with integrated parking. Those preferences have been incorporated into the visual representation for the best practice models as well.

The future status of parking may be unclear, but investments in the future-proofing of structured parking to allow for future flexibility are already underway. Interviews with members of the development community confirmed their desire for a set of standards and a clear understanding of costs. According to one interviewed developer, “We have talked about this and would be willing to invest more capital...to allow for reuse” (see Interview 5 transcript in Appendix I-2). Several respondents indicated that they would accept a premium of 20% per-space above current development costs to allow for future conversions (e.g., conversion-friendly floor-to-floor heights or increased deck loading capacity, or as separate express ramp structures in lieu of continuous ramped decks).

The recommendation outlined in this dissertation advises to develop structured parking that can be adapted to possible future residential and other uses, includes siting and orientating parking structures to permit adequate light and air. Structurally, preparation for the future includes addressing the strength and rigidity of the building itself, the planned floor-to floor heights, and the ability to deconstruct portions of the structure in the future (e.g., ramps) without major disruption. Like the overall guidelines for structured parking design, these recommendations for the futureproofing of parking were vetted with both focus groups and professional interview respondents in this research effort.

Areas of future research

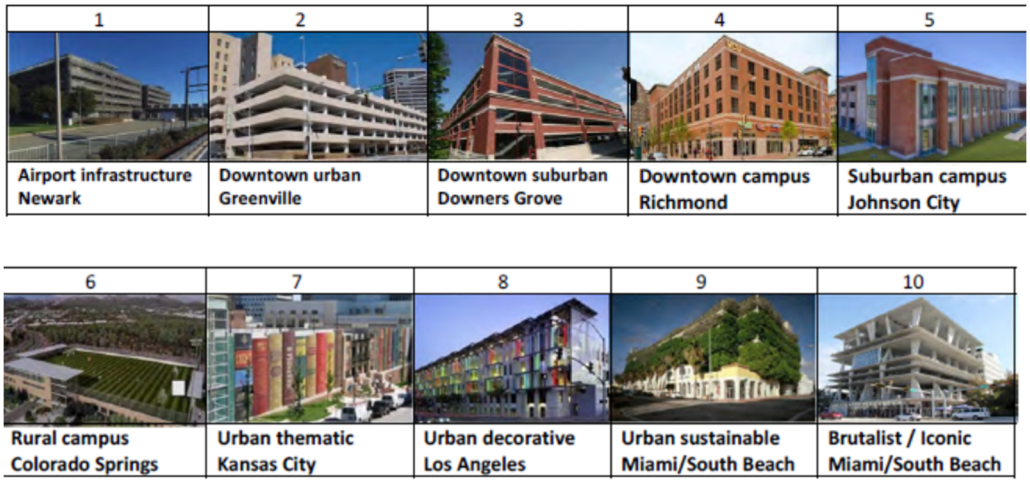
The findings of this dissertation point to five significant areas of future research. Based on these findings, the dissertation generated the following insights into topics related to structured parking:

1 The first area of future research includes further investigation into the relationship of VPS™ preferences by criteria for specific model prototype. This additional effort would be aimed at assessing the demonstrated and specific differentials between panels on a criteria basis. This additional effort would further demonstrate the observed variances between groups.

Chart 5.1 illustrates the focus group responses to a single criterion, Visual Representation, for the 10 existing structures tested. The individual responses for each of four focus groups—Panel 1 of Laypeople,

Panel 2 of Senior architects, Panel 3 of Millennial architects, and Panel 4 of Public officials—appear for each parking deck rated.

This further level of analysis enables the verification of the differentials found for the criteria utilized in these VPS™ sessions, as well as the overall preferences of focus groups by type. In both cases, the use of a criteria basis for evaluation is a viable extension of VPS™ techniques as demonstrated in this research effort.



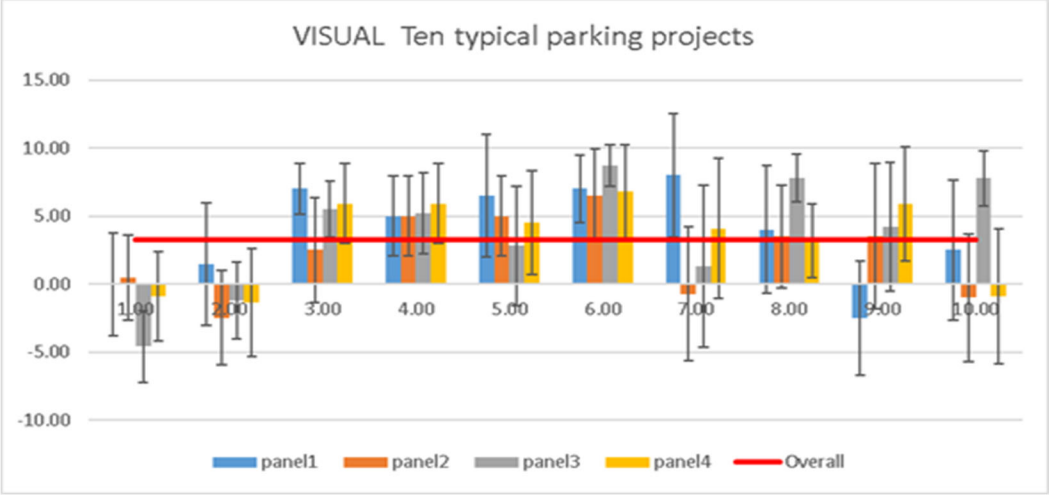


Chart 5.1. Visual representation ratings.

Focus group responses have been detailed by individual criteria for all illustrations, prototypes, and infill and case simulations.

Note: Ratings were gathered on both a pooled and individual criteria basis for all five criteria. This table represents the results for the 10 existing structures evaluated, and the corresponding rankings under the criteria "Visual representation" for each focus group panel. The mean response of all panels is indicted by the horizontal red line.

2. For each model and case presented, this dissertation has associated VPS™ ratings with the cost differentials derived from the pro forma financial analysis performed. By further incorporating VPS™ survey preferences for "designated upgrades" and associating them with the first two outcomes, it would be possible to extend the current research methodology in order to provide further insight into the data collected. Such an exercise would show the full set of variables over all prototypes and cases, forming a complete picture of panel responses for all sets of independent variables (prototype or case preferences, costs and costs and preference ratings including the series of listed upgrades). The set of variables required to extend this evaluation are as follows:

X1-6 (six prototypes valuations under the VPS™ focus group sessions)

X7-12 (monthly cost determined by pro forma for each prototype)

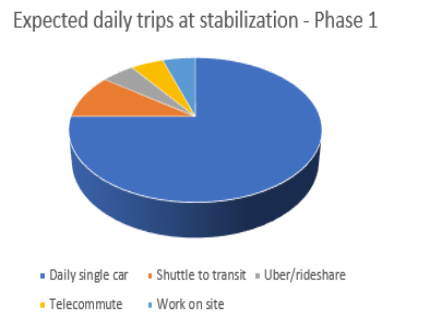
X13-48 (ratings of upgrades for each prototype in VPS™ sessions: mixed-use element, recreation feature, façade upgrades and style of parking, i.e., self-access, valet, or automated)

X49-84 (monthly cost determined by pro forma for all upgrades for each prototype)

$$Y = bo + b1(X1) + b2(X2) + b3(X3) + b4(X3) \ldots \ldots b84(X84)$$

3. In terms of ongoing trends impacting the future of structured parking, the future state is unclear. The lack of specific insight forces public boards to revert to old but safe standards and projections for parking demand. The next logical step would be to capture the anticipated scope and timeline for these transitions. This would facilitate the establishment of timeline for reductions in parking demand and would associate such reductions with the rise of specific alternate mobility options in a manner that directly and accurately represents these changes for various development scenarios. Chart 5.2 depicts this potential transition for a significant exurban site under redevelopment. This pie charts depict the portion of daily trips associated with five different modes of commuting. Over time, the assumption is that single-car occupancy and its associated parking requirement will diminish as rideshare, work-from-home and transit use rise. In a mixed-use setting, the ability to work on-site would impact these figures.

Mitigations per 100 trips	Current Phase 1	Mitigations per 100 trips	Year 15-20 Phase 4
Daily single car	75	Daily single car	30
Shuttle to transit	10	Shuttle to transit	20
Uber/rideshare	5	Uber/rideshare	20
Telecommute	5	Telecommute	15
Work on site	5	Work on site	15
	100		100



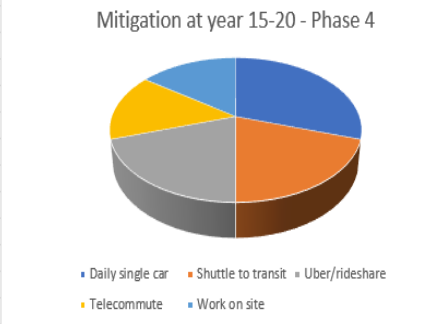


Chart 5.2. Potential phased mitigation of on-site commuting trips over time for a 2200-unit, mixed-use development in NJ.

This mitigation analysis is important because the development of hard data that depicts this transition in commuting patterns directly translates to a reduced need for infrastructure and structured parking within the development program. The need for differnet styles of parking, as well as the integration of transit malls and other drop-off and pick-up areas in a hub style format, is another outgrowth of the mitigation of on-site commuter trips. There is a need to provide hard data supporting this projected reduction in order for it to be actionable in the land-use approval process.

4. Further evidence of the feasibility of the transit hub and underground parking models could have significant impacts on the development of future communities. Such studies could include the architectural and engineering development of each model to a higher level of detail with associated detailed cost data.

a. In the case of the hub model, recent publications on the topic by organizations such as the Regional Plan Association (Regional Plan Association, 2018) have advocated for the integration of parking at rail and bus stops to create centers for transit that integrate other mobility options such as rideshare. One such regional strategy for the extension of hard rail transit is the adoption of rideshare and/or autonomous jitney programs to a hub site in order to provide transfers to traditional modes of transit at these locations. The development of bus malls for similar surface-transit hub locations is also an important component of the hub alternative (see Figure 5.2 for this iteration).

b. The development of an economical solution for underground parking deserves serious and long-term consideration. Pursuing a test case of the alternate technical approach to underground parking advanced by this dissertation represents a possible step toward making underground parking a more viable alternative.

5. These images (Figure 5.4) were presented in the focus groups to illustrate the sequence of modifications required for a transition from freestanding parking to a residential wraparound structure. They are also consistent with the low-rise, wraparound, mixed-use structure depicted in the best practice model for this dissertation (see Figure 5.2). This illustration details the conversion process from freestanding deck to wrap around low-rise mixed-use housing**.** (see Appendix B and J-6 for additional details of this model).

Figure 5.4. Conversion sequence from free-standing parking to mixed-use residential.

6. Further iterations of parking's potential role to assist in solving global issues related to sea level rise and resilience are illustrated below. Figure 5.4 addresses BIGs concept for a diked perimeter to lower Manhattan where a superposition of concepts for waterfront development indicates a role for structured depot parking as an element in Manhattan's waterfront redevelopment plan.

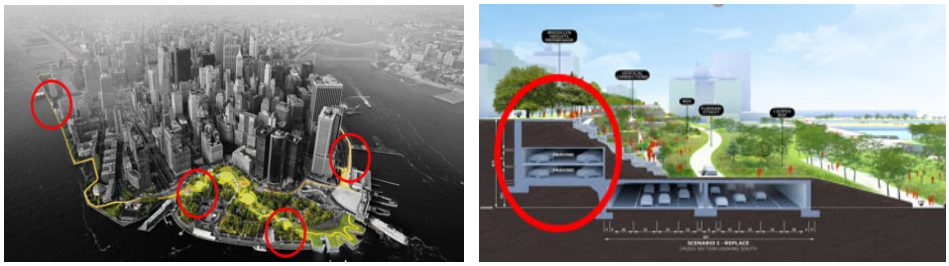


Figure 5.5 - BIGs concept for a resilient lower Manhattan is modified here to accommodate parking as a depot reservoir for autonomous vehicles and rideshare fleet vehicles.

A second illustration (Figure 5.6) depicts the construction of a raised street in adjacent Hoboken NJ, which is much like the turn of the century

historic street raisings in Chicago, IL. The ubiquitous construction of single-level podium residential buildings over the past decade leads to the obvious next iteration of raising streets to the first residential level, which provides a circulation zone that also accommodates needed upgrades to sewer, water and power infrastructure that is badly needed in that city. Clearly, the parallels to mid-century concepts furnished by Rudolph and referenced in Giedion are unmistakable (Freeman, 2010; Giedion, 1982).

Figure 5.6 Street raising in Hoboken, NJ accommodates upgrades in necessary infrastructure while accommodating vehicle movement at a lower circulation level.

The integration of parking in all of these forms points towards a future in which these accommodations serve uses that are larger and more purposeful than those imagined thus far.

Conclusions

The demand for parking will change over time, but it is not possible to conclude that the need for parking and parking structures will vanish altogether. In fact, the demand for structured parking could rise as new development and redevelopment efforts seek to achieve even higher levels of density. The prototypes and the standards that this dissertation derives to address the improvement of such developments' design and implementation and are notable, not merely for their success, but also for their applicability to a variety of settings.

Relevant and universal criteria

The five key criteria that guided this dissertation have proven to be in alignment with traditional urban design and planning standards. These criteria are relevant and comprehensible to both expert and non-expert users, as well as being non-situational, comparable, and quantifiable. This means that the best practice standards derived from them can be used with confidence. The relevance of the criteria to a range of audiences makes them especially useful over the lengthy private and public phases of the redevelopment process.

Demonstrates a greater role for structured parking

The three highest-ranked prototype models illustrate the possibilities for the future implementation of structured parking. The results of testing these models in a range of simulated settings have verified that they are adaptable and can be used in a range of urban, suburban and exurban environments. The models demonstrate how structured parking can better serve its context and its users when sensitively and

consciously developed, designed, and implemented. These intentionally developed parking structures may:

1. Become a gateway to a community, welcoming visitors and users;
2. Offer a satisfying human experience—one that is as engaging and unique as it is safe, secure, and easy to navigate on foot;
3. Bring together various modes of mobility, including transit, rideshare, and possible autonomous vehicle fleets;
4. Create a meaningful and organic connection to the street and public realm, presenting a clear identity and incorporating complementary retail, recreational, or other logical uses; and
5. Contribute to the overall quality and aesthetic of the urban spaces surrounding it by incorporating appropriate scale, massing, and visual treatments.

Aligns with public policy goals

The results of this dissertation align with larger public policy goals of Smart Growth and redevelopment policy. Further, the Regional Plan Association's Fourth Regional Plan addresses issues of uniting public transit and rideshare technologies, as well as the diminishing demand for parking and private vehicle use (Regional Plan Association, 2018).

The findings of this dissertation can be used as illustrations of the future effects of RPA's recommendations in the area of Transit hub design and densified and urbanized housing settings. The ultimate recycling of sites in and around transit stations

for the possible future state envisioned by RPA are also addressed in this dissertation, including flat lot and structured parking facilities. That alignment provides the current findings with direct applications, relevant utility, and a clear role in the larger public policy arena.

A proven method with a wide applicability

The results of this research effort validate a multi-method, multi-disciplinary approach to the examination of parking as a building type. This approach is analogous to those used in evidence-based design and can be used to address problems related to the analysis and reinvention of a variety of building typologies. This includes other elements of public infrastructure in the transportation arena; public works facilities, including parks and recreation spaces; workforce and special needs housing; and building types or uses in the areas of health, education/training, and public administration.

As the trends examined in this dissertation begin to take on a definitive and steady direction, these standards and best practice models may need to be revisited. The design of the original research process ensures that the simulations, evaluations, and focus group sessions serve as a benchmark that may be repeated to create guidelines that reflect future conditions and usage over a defined timeline.

A significant transition that transcends mobility, settlement patterns, and generational shifts is currently occurring. Broader considerations related to climate change, include weather patterns and sea-level rises, will affect built environments in all settings, including the people who live and work in them. The methodologies developed

for this dissertation can also be extended to develop, assess, and refine new building typologies and forms that are capable of responding to these challenges.

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Narrative to Appendix.

A series of ten appendices accompanies this dissertation. A brief description of each is as follows.

APPENDIX A is titled **Link to original models, videos and other exhibits** and consists of financial and visual models available by Dropbox link.

The financial models are "live" documents and consist of a financial pro forma developed for each prototype tested in this dissertation. Findings appearing In Chapter 4 and are related to economic outcomes described in that section and are built from the results of these model pro formas.

Visual models represent three dimensional depictions of the various prototypes as video simulations that were incorporated into VPS panel reviews for each focus group.

They can be viewed by clicking on the link and each live video feed as they appear.

APPENDIX B is titled **Link to architectural drawings and details** and consists of architectural drawings and studies for the several prototypes and best practice models depicted in this dissertation.

These drawings consist of architectural floor plans, elevations and building sections for each prototype model utilized in this research effort and are the basis for the iterative design studies depicted in the dissertation's Methods chapter.

They can be viewed by clicking on the link indicated.

APPENDIX C is titled **Best practice renderings of all highest rated models** and consists of enlarged illustrations for the three best practice models profiled in the dissertation's Findings chapter.

APPENDIX D is titled **Implementation strategies and Guidelines** and consists of Implementation strategies and Zoning and urban design guidelines for structured parking advanced by this dissertation.

They are drawn from historic architectural and urban design standards applied to this building typology and amended and adjusted by the results of panel responses to both visualizations and direct questions surveyed during those sessions.

APPENDIX E is titled **Visual Preference Survey Results** and consists of a narrative overview of focus group responses to each of three sets of exhibits and simulations. They encompass:

1) Ten built parking structures, 2) Six model prototypes in a downtown infill setting and multiple simulations for 3) Three selected case studies.

The charts that accompany the Appendix E's narrative depict the following:

1) pooled results of all panels, 2) individual results all of panels, 3) pooled results of all panels by criteria, and 4) individual results of all panels by criteria. These charts provide the raw data for the summary ratings of each model, prototype and cases depicted in the Findings chapter.

Statistical proofs for this data are also included in each chart. These responses are the primary results related to Research Question 1, The testing of structured parking implementation and applications through the five criteria.

APPENDIX F is titled **Binary questions – Future trends** and consists of a matrix of responses to a series of 25 direct questions posed to panel participants focused on issues of future demographics, mobility, and settlement.

Statistical proofs for each response are also included. These responses are the primary results related to Research Question 2, Future state of parking and mobility.

APPENDIX G is titled **Sizing surveys** and consists of a narrative overview of surveys conducted for this dissertation to address issues of sizing based on parking ratios and their application.

The surveys are summarized in both narrative, table and graph form and consists: of 1) demographic reviews of per household ownership; 2) a study of NJ Residential Site Improvement Standards (RSIS) parking ratios for various settings and housing unit mixes; 3) parking ratios of approved multi-family sites in relationship to distance to transit; and 4) a survey of parking utilization for a transit located site in Hoboken, NJ.

These studies were applied to parking prototypes and are useful in understanding the iterative design models developed and depicted in Chapter 3, Methods

APPENDIX H is titled **Economics of Parking** and consists of enlarged charts of financial models and results provided for clarity and consistent with charts as they appear and are described in the body of the dissertation, especially under Chapter 4, Findings.

APPENDIX I is titled **Transcripts VPS sessions and Professional Interviews** and consists of narrative summaries of panel and professional interviews as drawn from the transcripts for each session provided as well in this Appendix section.

These summaries inform the findings under Research Question 2 – the future state of parking and mobility.

APPENDIX J is titled **VPS Session Protocols** and consists of focus panel protocols and actual survey forms utilized in these sessions. A copy of an IRB certificate for anonymous interviews and panel sessions for this dissertation is included as well.

APPENDIX A

Link to original models, videos and other exhibits

https://www.dropbox.com/sh/6mm3fwevtiffo9i/AABbODKF3Ffs3EwxX6pNeijpa?dl=0

1 OVERALL VPS RESULTS POOLED DATA
2 OVERALL VPS RESULTS INDIVIDUAL DATA
3 FIVE CRITERIA VPS RESULTS POOLED PANELS
4 FIVE CRITERIA VPS RESULTS INDIVIDUAL PANELS
A CONSOLIDATED PRO FORMA - MIXED USE BLDGS - STRUCTURED PARKNG
B CONSOLIDATED PRO FORMA - PARKING DECKS
C ECONOMIC MODEL - RETURNS WITH ESCALATING LAND VALUES
SURVEY RESULTS - HOBOKEN TRANSIT MIXED USE BUILDING
VIDEO 1 INFILL SIMULATION MODEL
VIDEO 2 URBAN TRANSIT - LOW RISE WITH UNDERGROUND
VIDEO 3 URBAN TRANSIT- HIGH RISE AND FREESTANDING DECK
VIDEO 5 REGIONAL TRANSIT - LOW RISE MODEL
VIDEO 6 REGIONAL TRANSIT - MID RISE MODEL
VIDEO 7 REGIONAL TRANSIT - LOW AND HIGH RISE MODELS
VIDEO 8 EX URBAN CLUSTER - LOW RISE (Wrap-around)
VIDEO 9 EX URBAN CLUSTER - ALL MODELS
VIDEO 10 SUBURBAN TRANSIT HUB MODEL
VPS EXHIBIT 1 Ten test cases
VPS EXHIBIT 2 Prototypes
VPS EXHIBIT 3 Downtown infill contextual model
VPS EXHIBIT 4 Case Exhibits

APPENDIX B

Link to architectural drawings and details

https://www.dropbox.com/sh/e0jiop4a3vgotg4/AACB7dYFISOT4rabyWzpkKLva?dl=0

- 1 Best Practice Transit HUBs at Millburn and Chatham
- 2A Best practice - Wrap around mixed use - suburban exurban
- 2B Best practice - Wrap around mixed use - Infill urban site study
- 3 Best practice - Underground alternate Model (1)
- Architectural studies mixed use prototypes - Site development
- Architectural studies mixed use prototypes
- Case study overview Feb 2018
- Prototype_High Rise PDF
- Prototype_Podium PDF
- Prototype_Wrap-Around PDF

APPENDIX C

Best practice renderings of all highest rated models

C - 1 Local transit hub with recreation deck

APPENDIX C

Best practice renderings of all highest rated models

C - 2 Mixed use wrap around suburban / exurban application

APPENDIX C

Best practice renderings of all highest rated models

C - 3 Mixed use wrap around / urban application

APPENDIX C

Best practice renderings of all highest rated models

C - 4 Mixed use wrap around / urban application – Photo montage

APPENDIX C

Best practice renderings of all highest rated models

C - 5 Underground garage with recreation deck in a campus setting

APPENDIX D

Implementation strategies and Guidelines

D -1 Recommendations and Implementation strategies

Strategies for Implementation / Rules of the road.

Rule 1. Low scale is always good.

Low-rise wrap around and free-standing deck designs under three to four stories have the potential to be successfully integrated at the scale of a residential block or traditional downtown.

Rule 2. Mid-rise podium structures are perhaps the most ubiquitous of all of the building forms investigated.

Clad in every variety of fabricated urbanism these building's bases are becoming the dominant form of urban infill and their scale at even 4-5 stories in overall height is overwhelming. Parking may be concealed in this form but its translation as a building form that suits any purpose is troubling and a mistake. These massive intrusions simply up end traditional neighborhoods whose scale and delicate nature is being overrun by these buildings.

Rule 3. If super density is a must.

High-rise buildings of 8-40 stories or more that integrate parking at a mid-stack height allows the building to maintain an activated street front while segregating parking away from pedestrian zones. The inventive use of screening devices can include green walls, electronic billboards and displays along with architectural treatments that are engaging and contribute to street activity. For use in central city and dense urban clusters, these buildings still need to follow basic urban design standards. i.e. be placed along major corridors and be buffered by lower scaled uses and building forms that modulate the scale of their impact.

Rule 4. Sub grade garages in important and central urban spaces is the panacea of parking alternatives.

These structures have evolved in the European model to automated sub grade garages of sophisticated technical and mechanical content. Underground garages are extreme in cost per space which accounts for their limited ultimate use. The failure of this model to take hold here in the states is also linked to cultural norms that undervalues the benefits of open space and public amenity in contrast to European expectations. A model incorporated into this dissertation attempts to mediate several of the larger cost components of underground garages, mechanical venting and structural costs. Of all the forms of parking, underground structures require a serious investment of engineering and design talent to find viable future solutions to this underused building form.

Rule 5. The urban or suburban transportation HUB as a model is something that's gaining currency.

Integrating rail (if available but not a necessity), bus malls, autonomous and ride share pick up and drop zones, bicycle and scooter storage and a variety of community-based uses including recreation fields is going to be a mode of the future. One huge advantage is the HUBs ability to offer flexible parking for commuters on weekdays and then sports and entertainment venues at night and on weekends. Converting today's park and rides is a target for this model, and one that can recycle an otherwise desolate cast-off space to new community-based uses day and week-long.

Rule 6. **Sharing to offset parking demand can be done in several forms.**

Strategy 1. Local zoning is adopting parking sharing formulas that stress bundled peak use for a variety of mixed-uses. Contracted arrangements with adjacent property owners and local authorities can expand the reach of these programs. Reductions of as much as 20-25% in parking capacity can be had through this approach.

Strategy 2. When local publicly and operated parking facilities exist, projected capacity can be allocated to that public facility at a prescribed ratio. Projecting an ultimate downsizing of demand thru future trends, Uber ride sharing, autonomous jitney, and roving fleets of shared autonomous taxis, up to 50% of a project's anticipated demand can be off loaded to a public facility , the balance built on site. With this approach the downsized demand for parking, if and when realized, can result in the redistribution of the parking authorities reserved spaces to other projects and other uses. The public deck in essence acts as a reservoir for parking demand, flexible over time to accept and reject users as capacity is required.

Rule 7. **Planned conversion of new parking to alternate uses is a must.**

Anticipating change is a must for any structure built today considering its likely 30-40 years of useful life. Whether that transition is simply from one mode of parking to another, i.e. self-park to valet and autonomous self-directed storage or involves complete transformations of these structures to housing and recreation uses, these changes are coming and should be invested in now.

Flat plate floors, with structural integrity for new uses, removable express ramps, and siting that allows future exposure for residential and office fronts is a must.

Rule 8. Placement in the street scape matters.

a. Begin with siting structures in alignment with street walls with an active lower floor of retail and potential office uses at the upper floors. This liner feature helps buffer parking from the sidewalk and assures safe observable pedestrian zones.

b. Over time the ground floor of parking structures will convert to autonomous ride share depots with intense pick up and drop off zones. Surrounding side streets need to accommodate these transitions as well. The exact scale of this transition in modes of access is not known but still needs to be anticipated.

c. Control curb cuts. Preferably place access and egress points at the adjoining minor streets. But if access is required at the major frontage, keep it concise, bundled and visible for obvious pedestrian safety reasons.

d. Conform to basic base height and setback parameters that limit frontages to maximum heights depending on the size and scale of the street adjacent frontage. Cladding within that height limit should be engaging, and above that height screening of a variety of forms can be appropriate.

e. Parking is inherently unsustainable as a building type, but that does not mean that there aren't means available to limit its carbon footprint including green elements, efficient lighting systems and drainage and detention systems that control pollutants that accumulate on the parking surface

f. Safety first. Parking is still considered by many as a threatening and unsafe zone. Visibility first and foremost in entry and egress zones, transparent stairs and

corridors are paramount. Open and observable is the first and best system before all other security programs to make parking secure.

g. Remember that over time pick up and drop off zones will predominate and must be integrated into the city space. The assumption is that curb side parking will for the most part be eliminated in the downtown zone, but parking structures themselves will be transformed and become a place of hyperactivity where pedestrian safety is primary.

Rule 9. Integrate

Parking provided in integrated plans with associated mixed uses, varying scales and densities along with a variety of transportation and mobility options represents best practice. This approach also affords the greatest potential for well planned, appropriately sized and scaled parking solutions that are presented in a variety of massing and aesthetic forms and are well placed in a pedestrian and street scaled format.

Rule 10. Design matters.

There are numerous models including prototypes developed for this study along with a wellspring of sources and methods to help design parking as a meaningful component of an urban plan. The results of this dissertation effort match clear user preferences with cost parameters and a developed sense of the potential future state of parking These inputs couples with an understanding demonstrated in this dissertation that the cost of numerous upgrades to parking represent only a minor cost differential in the total scheme of development. This knowledge should lead to

larger investments in the visual quality of these structures with an emphasis on integrated mixed-uses, something all panel members in this research effort strongly advocate for. These steps hold the potential to transform parking to an effective and integrated element in the urban and suburban downtown setting.

Summary

Potentials that lie ahead for this building form includes possible landmark and gateway experiences, and the creation of truly integrated intermodal transportation zones in every city and town. The adoption of new evolving technologies including autonomous vehicles and ride share apps., automated and mechanical self-directed stacking systems, among others that are transitioning these building forms to something more.

Perhaps they can transform to even more than our imagination here to for has allowed. But if they fail to, then that failure lies with us and in our inability to conceive of a future space where these buildings, these massive investments in public and private infrastructure, have relevance and a role to contribute in the creation of a modern, urbanized and a culturally rich quality of life.

APPENDIX D

Implementation strategies and Guidelines

D - 2 Six guidelines

Six Guidelines

Dimensional constraints for infill building and parking and applicable to all building prototypes presented in this text.

1. **Sizing**

Sizing is determined by demand. Demand as projected results in requirements that determine current and future capacity (more likely consists of a downsized demand over time).

a. Encourage shared parking with adjacent and complementary uses to determine utilization and capacity required.

b. Review local authority capacity and resources to determine if off loading demand at certain times of the day is feasible. The reservoir of parking within walking distance should be looked at as a shared resource that can be distributed and redistributed on an as need basis.

c. Size parking according to a percentage of peak hour demand in lieu of the full peak projections. Consider all parking within walking distance when making this assessment.

d. Managing parking is fundamental to appropriate sizing. Ensuring that its always used at its maximum utilization/occupancy minimizes over building. Inventory apps. and other devices that locate and notice parkers of an available space via roadside information screens or phone applications are an inexpensive way to assure near 100% occupancy at peak hour.

e. Recognizing the need for transit in multiple forms is a must. Replacing parking through the use of multiple forms of transit, ride share, autonomous jitneys (when available) and biking and walking can lead to downsized parking demand.

f. Incorporating emerging cultural, demographic patterns including live/work and work from home/freelance employment, eliminates and reduces the need for parking.

g. Parking ratios derived from another era should be discarded and recomposed for a local context and modern setting and utility. Use of maximum allowable ratios limits the size of parking lots. Encouraging mixed-use applications and development scenarios that use these maxims thereby minimizing costs of built infrastructure and the destructive effects of a car centered anti-urbanism and anti-street life posture.

h. More intense and efficient use of parking can include tandem spaces, and long and short-term stacking and valet programs. 24/7 access to self-park vehicles is no longer a must, these alternatives help minimize footprint while maintaining capacity.

2. Scale.

Bulk - building height and length are visually crucial and importance to any building's placement and its integration into its setting. Determine an applicable bulk by surveying adjacent and contiguous properties and those in proximity to a proposed site for parking structures.

Context matters.

a. If in a suburban downtown or an urban narrow street the base height should not exceed four residential stories/36' or 3 commercial floors /36'

b. If in an urban zone or a wide suburban street the base height should be the equivalent to 6 residential stories/55' or 5 office commercial floors/60'.

c. Stories above this base height should setback at a sky plane that is no less than a 5 on 10, 30-degree angle with the 5' as the base point. Setbacks and their visibility are matters of perception and study and can vary.

These determinations are context driven but every setting has an appropriate standard that can be determined by survey and recording the scale of adjacent structures.

3. **Massing.**

a. Building mass for a new freestanding parking structure should be limited to no more than a 200'x200' footprint or a 40,000-sf floor plate, 95 spaces for any single element of the complex.

b. If the size of the structure is larger, then it should consist of a number of similar sized elements at these dimensions composed in modulated and offsetting forms. Utilizing this massing guideline can assure that the overall mass and scale of a structure remains within a controllable dimension.

c. These dimensional constraints also assure a module of roughly one third of a standard city block and street grid which averages 200'-250'x700' per block in most American cities. (See diagrams at end of this section for the relationship of basic parking modules to block and street dimensions)

d. Breaking down the massing of any building is always appropriate but can be problematic for parking which relies on regular and consistent floor plates. The diagrams furnished below and cited in the Appendix help illustrate the relationship of parking footprints to standard city blocks where dimensions become important to its ultimate efficiency and utility.

e. Whenever possible stair and elevator towers at junctures of these basic building blocks should be used to offset heights and setbacks and to distinguish one element from another.

f. Wherever possible use building wrappers or liners of residential, office and retail uses to encase parking .

g. To plan for future conversion offset the face of parking by a dimension of 35' (the average depth of a single loaded apt. block) to allow for residential infill. See Appendix, for models that illustrate methods to implement this conversion.

4. Visual / Aesthetics.

Screen parking floors or levels along all pedestrian fronts, by a variety of approaches.

a. Mixed uses integrated into parking, especially at ground floor frontages is a must.

b. Match adjacent architecture and modulated to simulate a regular and incremental massing. i.e. individual store or building fronts in a traditional street setting.

c. Decorative architectural elements should be selected for their appropriateness to adjacent buildings and forms. Screening materials should evoke interest, light with colors appropriate to their settings

d. Digital or billboard effects and displays. Active and engaging and focused at the street space. These approaches are particularly appropriate for downtown buildings in public places or for parking decks along highway settings were digital advertising is normal and appropriate.

e. Green facades that include a variety of design and planting programs are effective as well.

5. Placement in the street space.

Two choices exist. The first is a location in the center of activity, the second is a location accessible by foot or transit but outside the confines of public view and impact.

1 Central city locations especially at public squares and plazas require minimal impact

and complete discretion. Sub grade garaged structures, despite the extreme cost have a role to play in this context. Underground garages preserve open public spaces while providing accessible parking at prime points in the city. Care must be taken in siting entry and egress points of vehicles, pedestrians, transit/bus/jitney, rideshare, etc.

2 Remote structures require shuttle and jitney links to specific locations. As ride share and autonomous fleet vehicle systems gain traction, remote structured parking should become an important focus of public investment.

3 Parking structures must be integrated into the street scape.

a. Front facades and street liners along the public realm, should be located at the ground floor with an active retail or other street focused use. That liner should extend the full width of the front facade excluding points of access and egress

b. Points of access. Points of access and egress, driveway aisles, should preferably occur at the side streets but if occurring at the frontage, they should be bundled to minimize the number and size of curb cuts which disrupt pedestrian movement and safety.

c. Parking levels at the street line should be flat plate with all ramping or pitched floors running away from the street and not obvious from that frontage. This provides a normal and regular series of building elements that can be overlaid with appropriate exterior treatments and avoids a gymnastic visual effect of the building structure from the ground plain.

d. Being alert to opportunities to frame local landmarks and important points of juncture in a street system is also important.

6. **The parking structure as a transit HUB and mobility transfer zone**

Understanding the larger role these structures can play requires only looking towards the traditional role that major port, ferry and train terminals of the past once fulfilled. The HUB as a Gateway to the city and an integrator of multiple modes of mobility along with its role as a public space in and of itself should be regarded. To this extent including public concourses, public uses, recreation and retail uses within the structure itself helps define a parking structure as a point of entry, embarkation and greeting to the civic space. This is an opportunity that should be sought and a redefinition for parking that should be embraced when planning and designing transit HUBs for the future

7. **Summary, key points, guidelines**

Comments and recommendations from interviews – overview of subject comments.

a. Determining the size and scale of parking amenity in any proposal is a process of negotiation with local town officials, zoning standards and a sense of user demand is required.

b. Beyond code requirements is the perception of market and demand that effects absorption, rental rates and economics of the development for the intended target user.

c. Public parking access is used as a genuine lever in controlling or limiting development activity. Control of volume of community building is a political act and based on a community perception of what is tolerable

d. The ultimate scale and massing of these structures is a direct offshoot of the factors above and the relative densities being sought in the redevelopment proposal. Of late

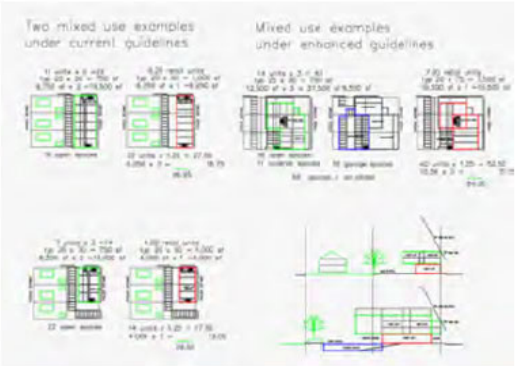
super densities in excess of 65-75 units per acre and as high as 125 units per acre are being sought in many urban, suburban and ex-urban clusters. These densities require new design and planning approaches as illustrated in this dissertation.

e. The aesthetics of these buildings are directly related to the style and scale of the context and the office, retail and residential structures that accompany these parking structures. As super scaled developments emerge an entirely new context is being proposed to which these structures must yield to in their style and definition and overall aesthetics.

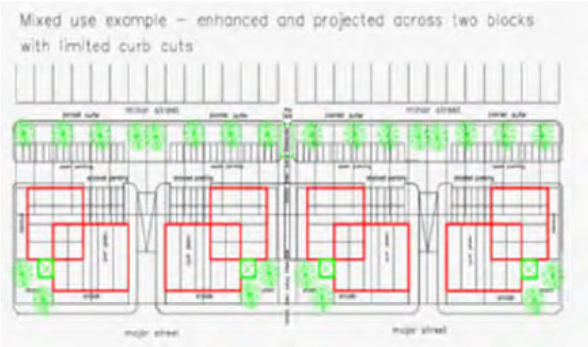
Diagrams for typical parking structures and their relationship to street grids and block dimensions.

Illustrations of iterative design studies leading up to full prototype models

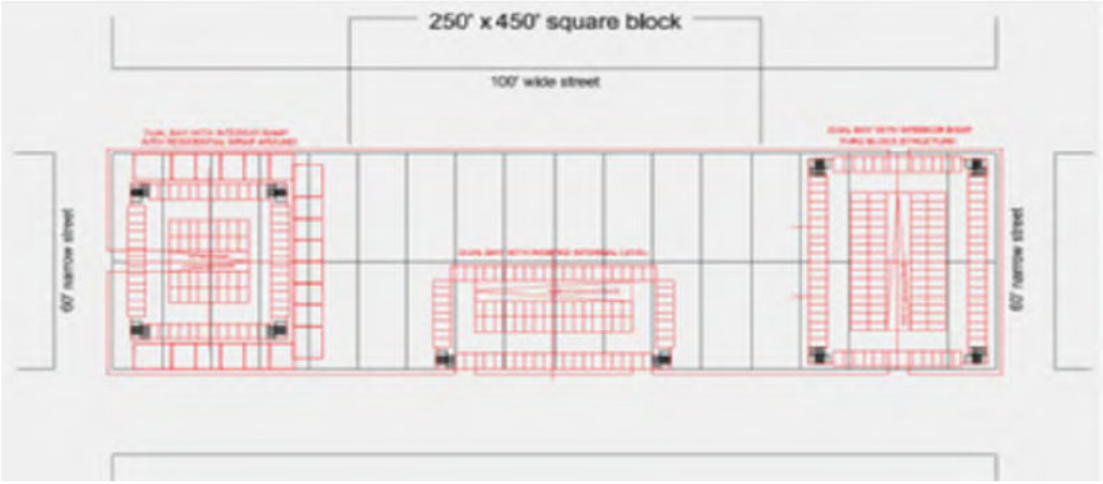
Platform infill structures on small lots.



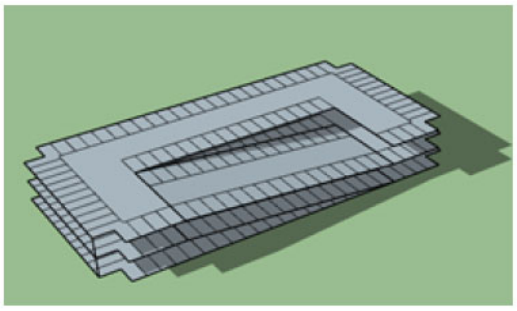
Full block infill with partially buried parking



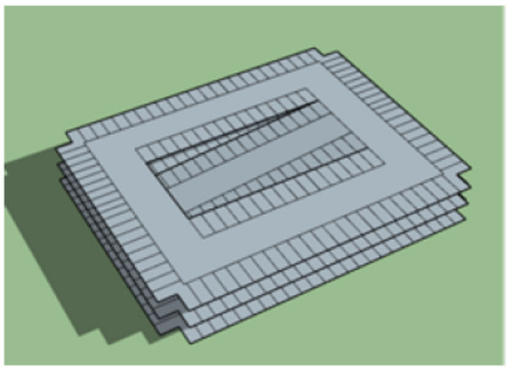
Full block overlays of dual and triple bay structures to assess fit, access options and orientation

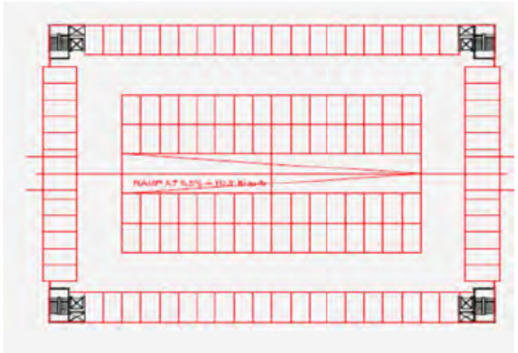


Option 1. Dual bay with a single ramped floor



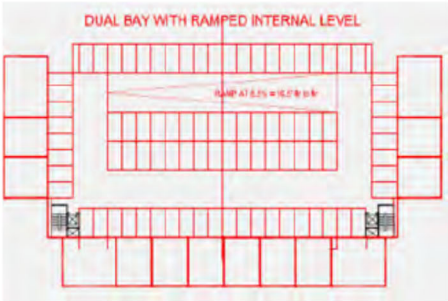
Option 2. Triple bay with a single internal speed or parked ramp.



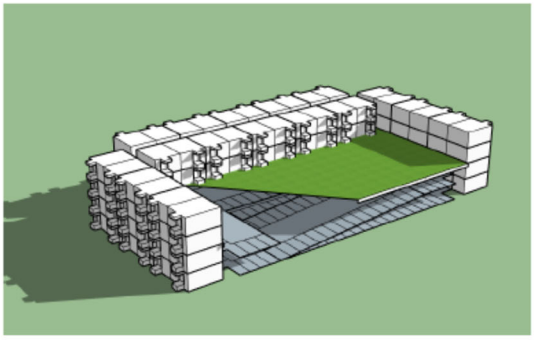


Option 3 ane 4. Next level iteration for dual and triple bay structures with wrap around residential

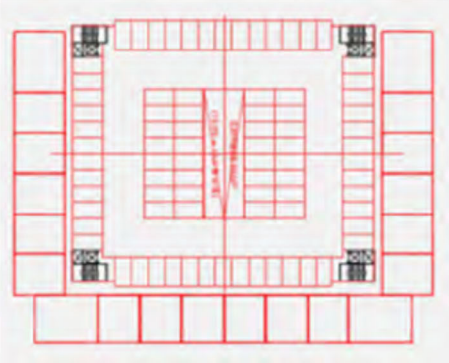
Dual bay structure with parked ramp



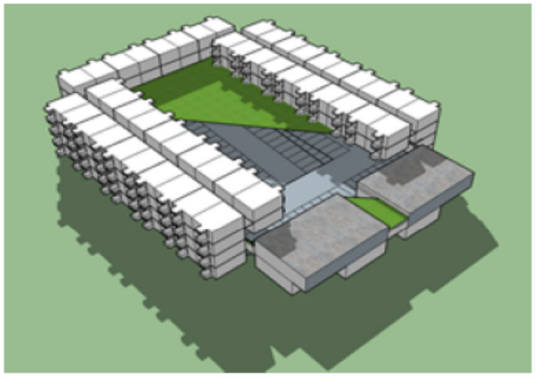
3D model – Dual bay garage



Triple bay structure



3D model – Triple bay garage



Triple bay structure incorporating an internal speed ramp and tandem spaces

APPENDIX E

Visual Preference Survey Results

E -1 Overview narrative – VPS results

Looking to build examples to illustrate the parameters and to demonstrate the effects of the criteria.

Each focus group's examination of built structures began with ten options, the majority of which were either two-bay or three-bay garages, in a variety of contexts from urban and suburban downtowns to campus settings and urban infill scenarios.

1 Free standing parking deck types examined to address issues in RQ 1

All panels demonstrated a clear preference for structures of two basic types: an integrated, mixed-use downtown structure with an active ground floor, and the mixed-use structure on campus with additional integrated uses: recreation, security and campus health.

The downtown decks scored well above the average with weighted positive scores of 3.66 and 3.33 (on a scale of -10 to + 10). Close behind the on-campus, mixed-use, recreation-topped deck scored a 3.54, followed by the mixed-use on-campus gateway building which scored 2.97.

Review of scoring by panel																
Ten typical parking structures							Lay panel		Architects seniors		Architects Millennial		Public bd members			
Case	Location	Type	Location	Mixed or Single use	Description	Style and aesthetic	Raw score	Weighted score	Raw score	Weighted score	Raw score	Weighted score	Raw score	Weighted score		
1	Newark, NJ	Freestanding	Airport infrastructure	Single	Metal screening	Contemporary	3.48	2.55	1.50	1.21	-1.12	-0.86	1.53	1.19	**4.09**	**1.02**
2	Greensboro, NC	Freestanding	Downtown Urban	Single	Concrete panels	Contemporary	2.59	1.91	-0.42	-0.34	2.10	1.70	1.33	1.02	**4.29**	**1.07**
3	Downers Grove, IL	Freestanding	Dowtown Suburban	Single	Brick and stone veneer	Transitional	5.10	3.94	3.60	2.90	3.56	2.85	4.51	3.65	**13.34**	**3.33**
4	Richmond, VA	Freestanding	On campus Urban	Mixed	Brick and stone veneer	Traditional	4.20	3.22	5.30	4.23	4.36	3.50	4.53	3.68	**14.63**	**3.66**
5	Johnson City, TN	Freestanding	On campus Suburban	Mixed	Brick and stone veneer	Traditional	5.10	3.98	3.00	2.41	2.22	1.77	4.71	3.74	**11.90**	**2.97**
6	Colorado Springs, CO	Freestanding	On campus Rural	Mixed	Concrete and metal	Contemporary	3.20	2.57	4.25	3.41	4.40	3.51	6.35	5.05	**14.55**	**3.64**
7	Kansas City, MO	Freestanding	Downtown Urban	Single	Concrete and metal	Thematic	5.10	4.06	0.85	0.70	3.34	2.69	3.98	3.17	**10.63**	**2.66**
8	Los Angeles, CA	Freestanding	Downtown Urban	Single	Concrete and glass panels	Decorative	3.00	2.30	2.20	1.75	5.52	4.44	2.53	2.11	**10.60**	**2.65**
9	Miami, FL	Freestanding	Downtown Urban	Mixed	Concrete w/ Landscape grid	Decorative	0.60	0.39	2.40	1.93	4.86	3.91	4.07	3.34	**9.56**	**2.39**
10	Miami, FL	Freestanding	Downtown Urban	Mixed	Concrete / Brutalist	Decorative	3.50	2.75	1.00	0.78	3.44	2.81	0.80	0.62	**6.96**	**1.74**
							35.87	27.67	23.68	18.97	32.68	26.32	34.35	27.57		
								2.77		1.90		2.63		2.76	7.29	
															1.82	

2 Infill simulation

A simulated downtown setting provided a means for examining six prototypical parking structures. Half of this group represented traditional approaches to parking structures, while the other represented mixed-use downtown infill buildings with integrated structured parking.

Review of scoring by panel															
Prototype models for parking structures and mixed use infill with strucured parking						Lay panel		Architects senior		Architects Millennial		Public bd members			
Case	Type	Location	Mixed or Single use	Description	Style and aesthetic	Raw score	Weighted score	Raw score	Weighted score	Raw score	Weighted score	Raw score	Weighted score	All panels	
1	Freestanding	Infill simulation	Single	Concrete panels with graphic advertising displays	Contemporary	3.33	2.41	0.28	0.23	0.80	0.65	3.09	2.42	**5.71**	**1.43**
2	Underground garage	Infill simulation	Single	Undergrouind self access of mechanical / robatic	NA	6.27	4.76	4.00	3.20	4.00	3.21	3.53	2.82	**13.98**	**3.50**
3	Freestanding Transit HUB	Infill simulation	Mixed Retail and recreation	Concrete panels with graphic advertising displays	Contemporary	6.61	5.14	5.39	4.33	4.50	3.61	5.51	4.40	**17.48**	**4.37**
4	Wrap around	Infill simulation	Mixed Retail and residential	Brick and stone veneer	Traditional	5.47	4.38	5.47	4.38	4.44	3.56	3.92	3.17	**15.49**	**3.87**
5	Podium	Infill simulation	Single	Brick and stone veneer	Traditional	5.94	4.58	-0.09	-0.07	2.20	1.75	3.74	3.08	**9.35**	**2.34**
6	High rise with mid stack parking	Infill simulation	Mixed Retail and residential	Brick and stone veneer	Traditional	1.86	1.58	1.60	1.29	0.40	0.28	2.64	2.16	**5.31**	**1.33**
						29.48	22.86	16.65	13.35	16.34	13.06	22.43	18.05		
							3.81		2.22		2.18		1.81	**10.02**	
														2.50	

Responses to the simulation resulted in clear, clustered favorites and non-favorites.

The “favored” set included:

1) the mixed-use transit located freestanding structure with recreation deck with a 4.37 rating

2) the low-rise wrap-around residential building with an active frontage with a 3.87 rating

3) the underground garage a 3.50 rating

The less-favored set consisted of:

4) the podium mid-rise residential building with a 2.43 rating

5) the freestanding single use unadorned parking deck with a 1.43 rating

6) the high-rise office and residential prototype with mid-stack parking with a 1.33 rating

Further analysis of these prototypes follows in Section 1 above: Ten built structures. The accompanying chart provides insight into individual criteria and its overall detail of each of the six prototypes illustrated.

3 Three development sites and seven iterations of approaches to parking

As with the earlier studies conducted above, the results for the various cases presented, fall into distinct groups. Low-rise wrap-around mixed-use approaches to parking scored the highest in all cases and on all three sites: urban transit, suburban regional transit and the exurban cluster. Only in one setting did the choice of high-rise structures with mid-stack parking score well. That option, the exurban cluster, integrated four of the six prototypes as a uniform planning approach of related buildings. The incorporation of high-rise and mid-rise buildings scored low in both the urban transit and suburban regional transit sites.

Review of scoring by panel																
Prototype models for parking structures and mixed use strucured parking - by Urban, Suburban and Ex urban case studies							Lay panel		Architects seniors		Architects Millennial		Public bd members			
Case	Location	Type	Location	Use	Description	Style and aesthetic	Raw score	Weighted score	Raw score	Weighted score	Raw score	Weighted score	Raw score	Weighted score		
1A	Newark, NJ	Urban central city	Broad Street Station	Retail and residential	Resdientaal wrao around with retail groudn floor and underground garage	Tradtional	7.75	5.96	4.88	3.92	4.89	3.85	4.52	3.67	**17.41**	**4.35**
1B	Newark, NJ	Urban central city	Broad Street Station	Retail and residential	High rise residential with retail ground floor and mid stack and freestanding parking	Tradtional	3.26	2.56	2.20	1.76	1.44	1.20	1.30	1.17	**6.68**	**1.67**
2A	Iselin, NJ	Suburban regional transit	Metro Park Station	Retail and residential	Residential wrap around with retail ground floor and decked parking	Transitional	8.33	6.30	4.61	3.70	4.27	3.33	5.42	4.35	**17.67**	**4.42**
2B	Iselin, NJ	Suburban regional transit	Metro Park Station	Retail and residential	Podium residential with freestanding commuter deck	Traditional	6.67	5.09	2.39	1.91	2.11	1.64	2.86	2.28	**10.92**	**2.73**
2C	Iselin, NJ	Suburban regional transit	Metro Park Station	Retail and residential	High rise and wrap around residential with retail ground floor and mid stack and decked parking floor	Traditional	2.50	2.02	0.84	0.69	-1.33	-1.01	0.76	0.72	**2.42**	**0.60**
3A	Parsippany, NJ	Ex urban cluster	Obsolete office park scheduled or redevelopment	Retail and residential	Residential wrap around with retail ground floor and decked parking	Tradtional	6.37	4.88	0.95	0.69	4.67	3.59	4.70	3.76	**12.93**	**3.23**
3B	Parsippany, NJ	Ex urban cluster	Obsolete office park scheduled or redevelopment	Retail and residential	High rise, podium and wrap around residential with retail ground floor and mid stack and decked parking floor Transit HUB with mixed use retail/recreation on site	Tradtional	4.68	3.65	3.56	2.85	4.00	3.15	1.53	1.19	**10.84**	**2.71**
							39.56	30.46	19.43	15.51	20.04	15.76	24.17	17.52		
								5.08		2.59		2.63		1.75	**10.22**	
															2.56	

Panels also responded favorably to other features of these development scenarios, which included active retail frontages, integrated open space, and defined bus and jitney malls with designated pick-up and drop-off zones for ride share and autonomous vehicles.

Surprisingly, all panels, save for the senior the architects, elected the low-rise solution for the preferred plan. The implication is that moderate and high-density solutions are not

driven by the public, nor by the design and planning communities, but rather by the development community and its perception of the economic constraints of redevelopment programs.

4 The element of visual representation

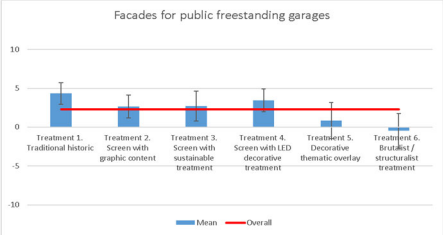
In second set of comparisons that focused directly on visual treatments the results are consistent. For freestanding structures traditional facades scored higher than screened or decorative façades (earning a score of 4.33 on a +10 to -10 scale). Rationalist / brutalist treatments scored lowest at -0.49).

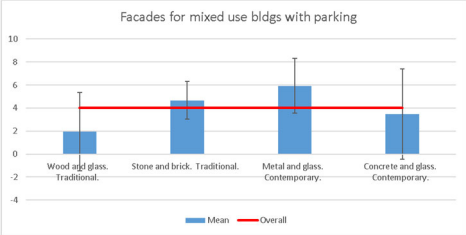
The concept of cladding these buildings with facades that obscure or hide their actual use and function is clearly the preferred approach. This preference clearly contrasts with modernist dogma that insists that building facades are expressive of a buildings internal function and organization. On an individual basis the lay, public officials agreed with these scores, surprisingly Senior architects did as well though they did score the sustainable screen somewhat higher. Millennials on the other hand showed a clear preference for decorative screened facades above all others and across the board.

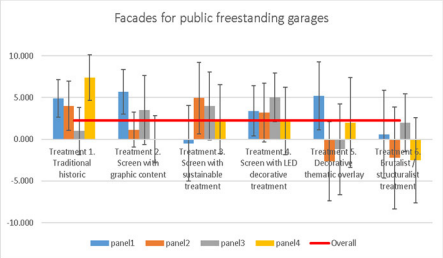
The mixed-use buildings, contemporary glass and metal treatments received a score of 5.99 while traditional brick/stone facades and contemporary treatments scored a 4.66. Wood and siding treatments scored lowest at 1.94 on average. The general acceptance of more contemporary, hardedge approaches was surprising. There was consensus from all panels in these findings with lay users in higher agreement with these approaches.

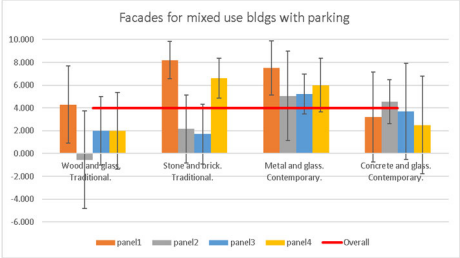
The score for a more contemporary image for mixed-use was favored over the treatments for freestanding structures of all descriptions. The margin was on average 2 to 1 in favor of mixed-use facades vs the all treatments indicated for the freestanding structures – a 2.26 mean vs a 4.01 mean for all mixed-use treatments.

1 Facades for public freestanding garages	Question	Mean	Overall	Std. Devia	95% marg	Std. Err. o	p-value t-	significant at 95% conf. level		
Treatment 1. Traditional historic	301.00	4.33	2.26	4.30	1.38	0.68	0.00	1.00		
Treatment 2. Screen with graphic content	302.00	2.65	2.26	4.58	1.49	0.73	0.00	1.00		
Treatment 3. Screen with sustainable treatment	303.00	2.71	2.26	6.09	1.95	0.96	0.00	1.00		
Treatment 4. Screen with LED decorative treatmer	304.00	3.45	2.26	4.67	1.49	0.74	0.00	1.00		
Treatment 5. Decorative thematic overlay	305.00	0.84	2.26	7.31	2.34	1.16	0.24	0.00		
Treatment 6. Brutalist / structuralist treatment	306.00	-0.49	2.26	6.88	2.23	1.10	0.67	0.00		
2 Facades for mixed use bldgs with parking	Question	Mean	Overall	Std. Devia	95% marg	Std. Err. o	p-value t-	significant at 95% conf. level		
Wood and glass. Traditional.	307.00	1.94	4.01	5.07	1.62	0.80	0.01	1.00		
Stone and brick. Traditional.	308.00	4.66	4.01	4.21	1.35	0.67	0.00	1.00		
Metal and glass. Contemporary.	309.00	5.94	4.01	3.79	1.21	0.60	0.00	1.00		
Concrete and glass. Contemporary.	310.00	3.49	4.01	5.04	1.61	0.80	0.00	1.00		









APPENDIX E

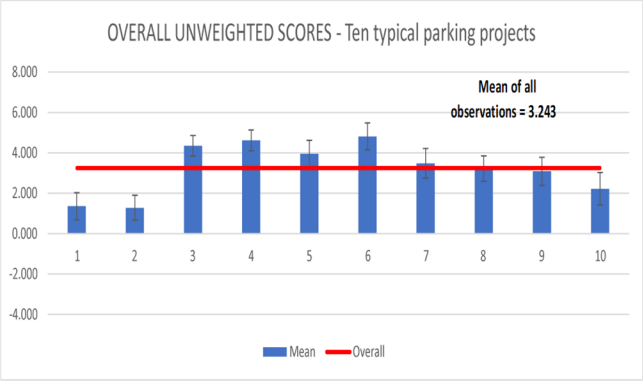
Visual Preference Survey Results

E - 2 Overall VPS results – Pooled data

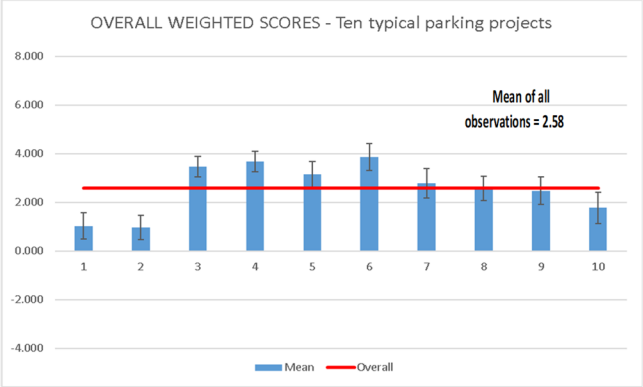
1 - Ten built models – Focus group preferences

1	2	3	4	5	6	7	8	9	10
									
Airport infrastructure Newark	Downtown urban Greenville	Downtown suburban Downers Grove	Downtown campus Richmond	Suburban campus Johnson City	Rural campus Colorado Springs	Urban thematic Kansas City	Urban decorative Los Angeles	Urban sustainable Miami/South Beach	Brutalist / Iconic Miami/South Beach

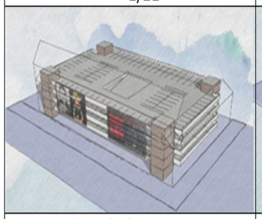
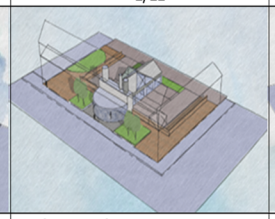
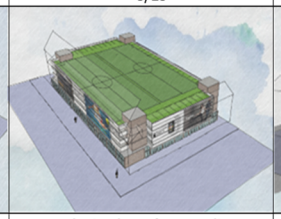
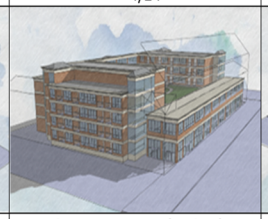
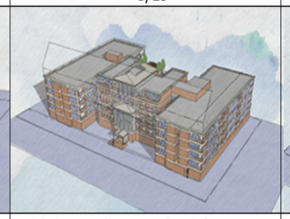
Project	Mean	Overall	Std. Deviation	95% margin of error	Std. Err. of the mean	p-value t-test mean > 0	significant at 95% conf. level
1	1.356	3.243	4.893	0.674	0.342	0.000	1
2	1.280	3.243	4.466	0.615	0.312	0.000	1
3	4.351	3.243	3.679	0.507	0.257	0.000	1
4	4.624	3.243	3.747	0.516	0.262	0.000	1
5	3.956	3.243	4.808	0.662	0.336	0.000	1
6	4.817	3.243	4.836	0.666	0.338	0.000	1
7	3.485	3.243	5.357	0.738	0.374	0.000	1
8	3.224	3.243	4.586	0.631	0.320	0.000	1
9	3.088	3.243	5.060	0.697	0.353	0.000	1
10	2.225	3.243	5.752	0.802	0.407	0.000	1



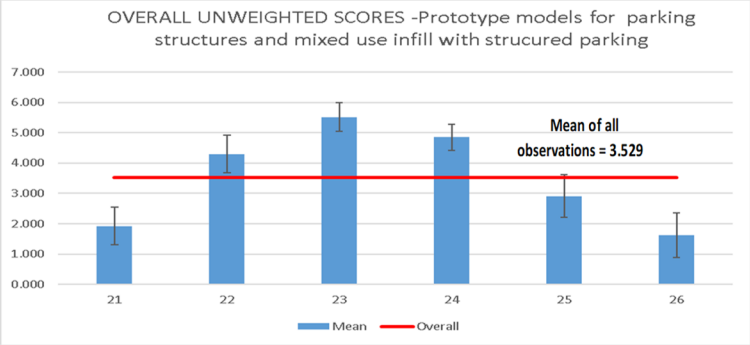
Project	Mean	Overall	Std. Deviation	95% margin of error	Std. Err. of the mean	p-value t-test mean > 0	significant at 95% conf. level
1	1.030	2.58	3.930	0.541	0.274	0.000	1
2	0.971	2.58	3.651	0.503	0.255	0.000	1
3	3.472	2.58	3.079	0.424	0.215	0.000	1
4	3.682	2.58	3.033	0.418	0.212	0.000	1
5	3.143	2.58	3.951	0.544	0.276	0.000	1
6	3.862	2.58	3.942	0.543	0.275	0.000	1
7	2.798	2.58	4.399	0.606	0.307	0.000	1
8	2.578	2.58	3.701	0.510	0.258	0.000	1
9	2.480	2.58	4.148	0.571	0.290	0.000	1
10	1.774	2.58	4.701	0.655	0.332	0.000	1



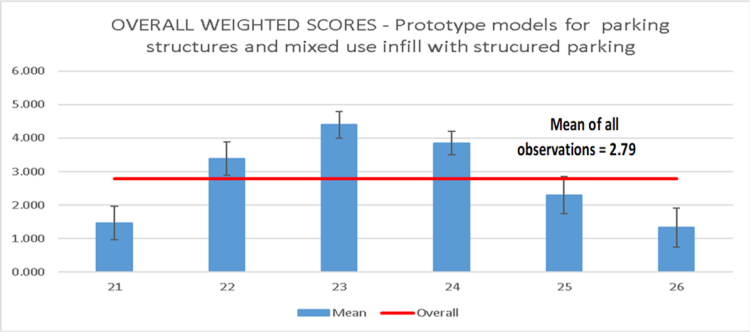
2 - Six prototypes – Focus group preferences

1/21	2/22	3/23	4/24	5/25	6/26
					
Freestanding deck	**Underground garage**	**HUB and mixed-use freestanding**	**Low-rise Wrap-around Mixed-use**	**Mid-rise Podium residential**	**High-rise Mixed use**

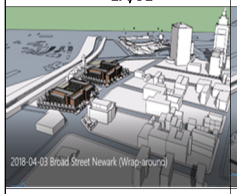
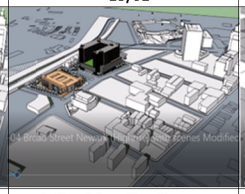
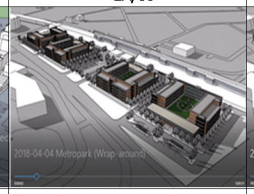
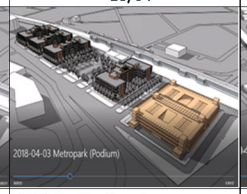
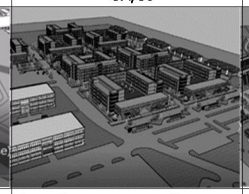
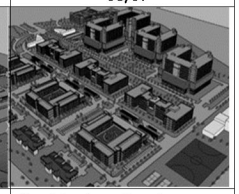
Project	Mean	Overall	Std. Deviation	95% margin of error	Std. Err. of the mean	p-value t-test mean > 0	significant at 95% conf. level
21	1.920	3.529	4.438	0.619	0.314	0.000	1
22	4.299	3.529	4.492	0.620	0.315	0.000	1
23	5.520	3.529	3.495	0.482	0.245	0.000	1
24	4.849	3.529	3.033	0.424	0.215	0.000	1
25	2.910	3.529	5.013	0.699	0.354	0.000	1
26	1.625	3.529	5.285	0.737	0.374	0.000	1



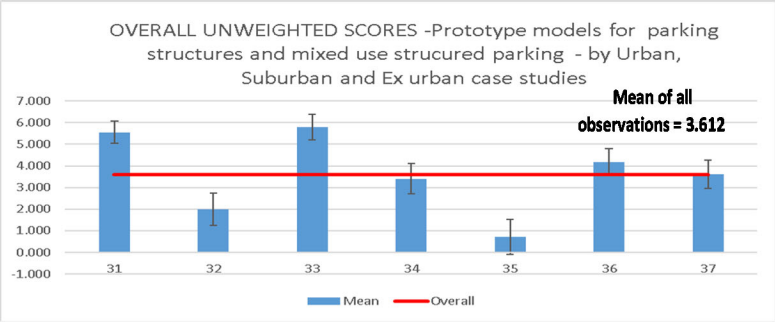
Project	Mean	Overall	Std. Deviation	95% margin of error	Std. Err. of the mean	p-value t-test mean > 0	significant at 95% conf. level
21	1.470	2.79	3.573	0.498	0.253	0.000	1
22	3.383	2.79	3.622	0.500	0.254	0.000	1
23	4.396	2.79	2.892	0.399	0.202	0.000	1
24	3.851	2.79	2.483	0.347	0.176	0.000	1
25	2.296	2.79	4.020	0.560	0.284	0.000	1
26	1.330	2.79	4.203	0.586	0.297	0.000	1



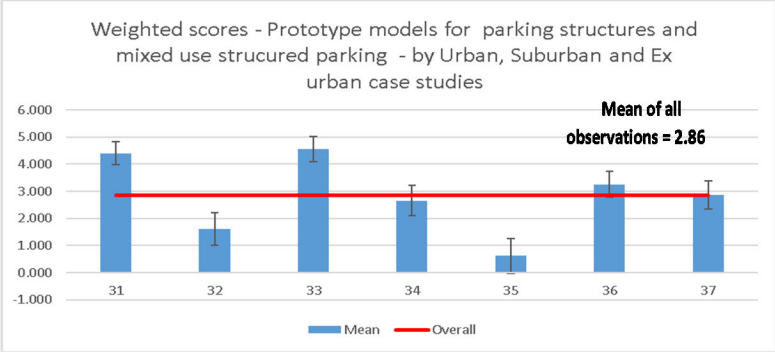
3 - Seven development options evaluated at three case locations – Focus group preferences

1A/31	1B/32	2A/33	2B/34	2C/35	3A/36	3B/37
						
Low rise wrap-around Newark Broad St station	High rise + freestanding Newark Broad St station	Low rise wrap-around Metro park Regional station	Mid-rise Podium + freestanding Metro park Regional station	Low rise + High-rise Metro park Regional station	Low rise wrap-around Parsippany ex urban cluster	Combined master plan Parsippany ex urban cluster

Project	Mean	Overall	Std. Deviation	95% margin of error	Std. Err. of the mean	p-value t-test mean > 0	significant at 95% conf. level
31	5.558	3.612	3.686	0.514	0.261	0.000	1
32	1.985	3.612	5.352	0.746	0.378	0.000	1
33	5.800	3.612	4.148	0.586	0.297	0.000	1
34	3.408	3.612	4.883	0.699	0.354	0.000	1
35	0.711	3.612	5.798	0.821	0.416	0.045	1
36	4.175	3.612	4.381	0.611	0.310	0.000	1
37	3.603	3.612	4.682	0.655	0.332	0.000	1



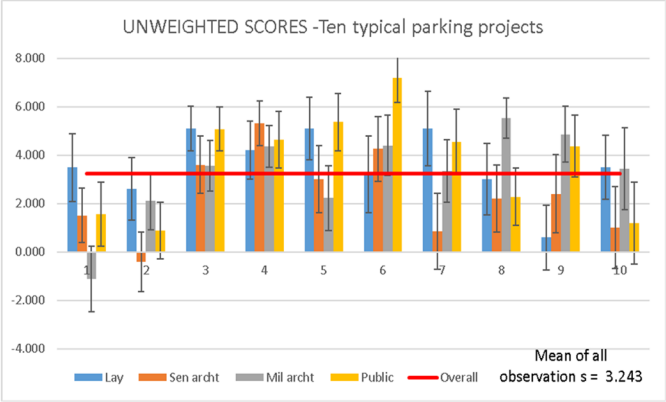
Project	Mean	Overall	Std. Deviation	95% margin of error	Std. Err. of the mean	p-value t-test mean > 0	significant at 95% conf. level
31	4.402	2.86	3.031	0.423	0.214	0.000	1
32	1.614	2.86	4.280	0.597	0.303	0.000	1
33	4.544	2.86	3.284	0.464	0.235	0.000	1
34	2.654	2.86	3.907	0.559	0.283	0.000	1
35	0.618	2.86	4.589	0.650	0.329	0.031	1
36	3.262	2.86	3.488	0.486	0.247	0.000	1
37	2.863	2.86	3.771	0.527	0.267	0.000	1



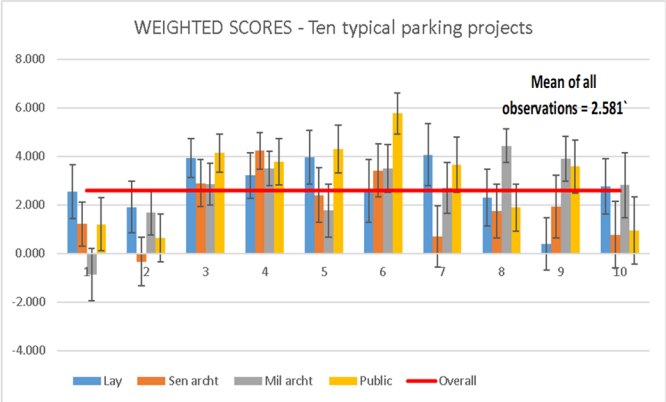
1 - Ten built models – Focus group preferences

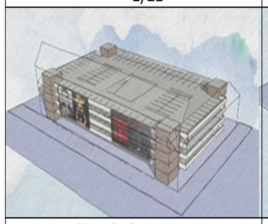
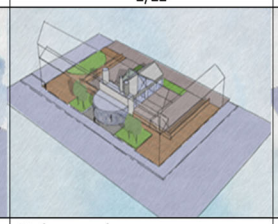
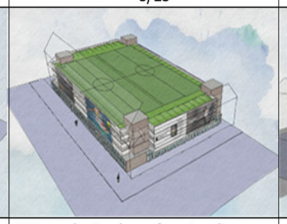
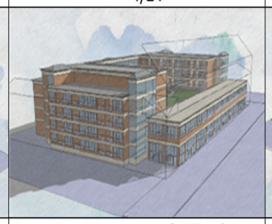
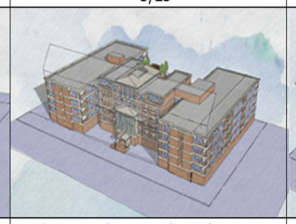
1	2	3	4	5	6	7	8	9	10
Airport infrastructure Newark	Downtown urban Greenville	Downtown suburban Downers Grove	Downtown campus Richmond	Suburban campus Johnson City	Rural campus Colorado Springs	Urban thematic Kansas City	Urban decorative Los Angeles	Urban sustainable Miami/South Beach	Brutalist / Iconic Miami/South Beach

p-value t-test mean > 0				significant at 95% conf. level			85% CL
Lay	Sen archt	Mil archt	Public	Lay	Sen archt	Mil archt	Public
0.000	0.005	0.948	0.011	1	1	0	1
0.000	0.752	0.000	0.067	1	0	1	0
0.000	0.000	0.000	0.000	1	1	1	1
0.000	0.000	0.000	0.000	1	1	1	1
0.000	0.000	0.001	0.000	1	1	1	1
0.000	0.000	0.000	0.000	1	1	1	1
0.000	0.141	0.000	0.000	1	0	1	1
0.000	0.001	0.000	0.000	1	1	1	1
0.186	0.002	0.000	0.000	0	1	1	1
0.000	0.121	0.000	0.083	1	0	1	0

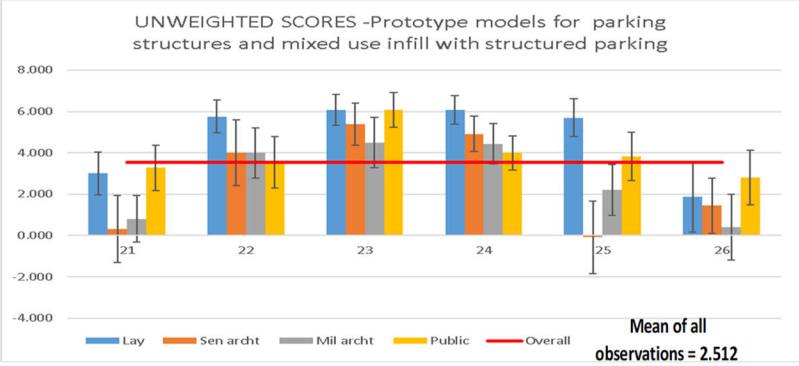


p-value t-test mean > 0				significant at 95% conf. level			85% cl
Lay	Sen archt	Mil archt	Public	Lay	Sen archt	Mil archt	Public
0.000	0.005	0.942	0.016	1	1	0	1
0.000	0.750	0.000	0.098	1	0	1	0
0.000	0.000	0.000	0.000	1	1	1	1
0.000	0.000	0.000	0.000	1	1	1	1
0.000	0.000	0.001	0.000	1	1	1	1
0.000	0.000	0.000	0.000	1	1	1	1
0.000	0.135	0.000	0.000	1	0	1	1
0.000	0.001	0.000	0.000	1	1	1	1
0.235	0.002	0.000	0.000	0	1	1	1
0.000	0.130	0.000	0.090	1	0	1	0

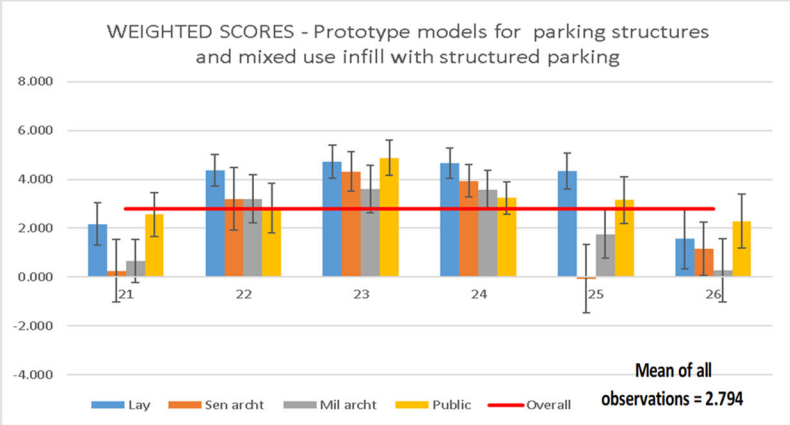


1/21	2/22	3/23	4/24	5/25	6/26
					
Freestanding deck	**Underground garage**	**HUB and mixed-use freestanding**	**Low-rise Wrap-around Mixed-use**	**Mid-rise Podium residential**	**High-rise Mixed use**

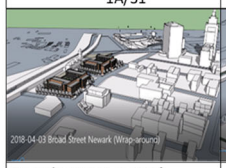
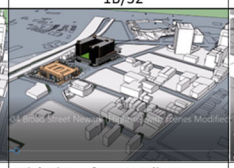
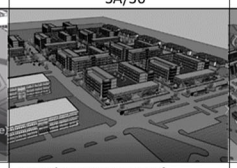
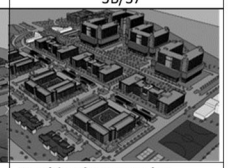
p-value t-test mean > 0				significant at 95% conf. level			85% CL
Lay	Sen archt	Mil archt	Public	Lay	Sen archt	Mil archt	Public
0.000	0.350	0.080	0.000	1	0	0	1
0.000	0.000	0.000	0.000	1	1	1	1
0.000	0.000	0.000	0.000	1	1	1	1
0.000	0.000	0.000	0.000	1	1	1	1
0.000	0.536	0.000	0.000	1	0	1	1
0.015	0.018	0.308	0.000	1	1	0	1



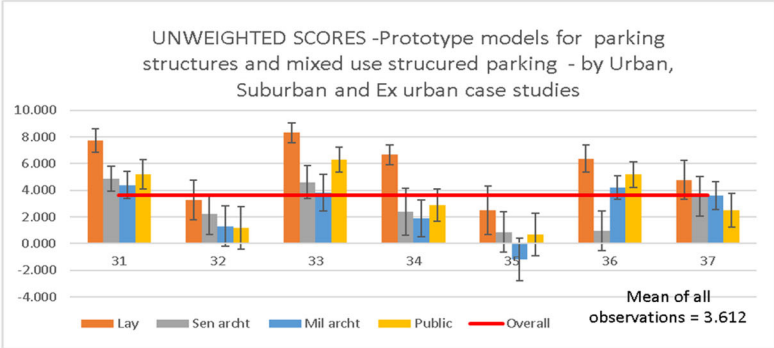
p-value t-test mean > 0				significant at 95% conf. level			85% cl
Lay	Sen archt	Mil archt	Public	Lay	Sen archt	Mil archt	Public
0.000	0.347	0.074	0.000	1	0	0	1
0.000	0.000	0.000	0.000	1	1	1	1
0.000	0.000	0.000	0.000	1	1	1	1
0.000	0.000	0.000	0.000	1	1	1	1
0.000	0.538	0.000	0.000	1	0	1	1
0.007	0.018	0.333	0.000	1	1	0	1



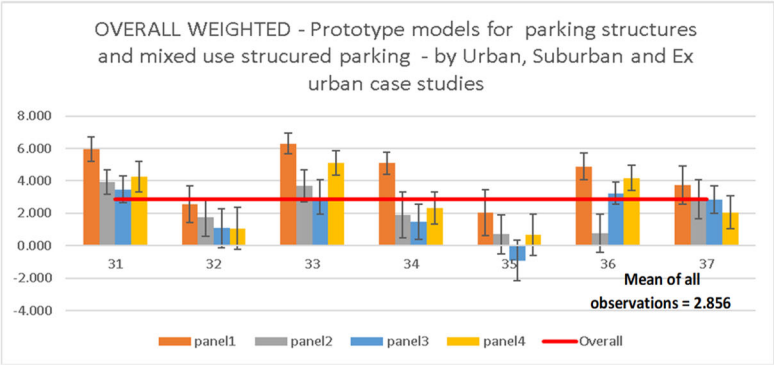
3 - Seven development options evaluated at three case locations – Focus group preferences

1A/31	1B/32	2A/33	2B/34	2C/35	3A/36	3B/37
						
Low rise wrap-around Newark Broad St station	**High rise + freestanding Newark Broad St station**	**Low rise wrap-around Metro park Regional station**	**Mid-rise Podium + freestanding Metro park Regional station**	**Low rise + High-rise Metro park Regional station**	**Low rise wrap-around Parsippany ex urban cluster**	**Combined master plan Parsippany ex urban cluster**

p-value t-test mean > 0				significant at 95% conf. level			85% CL
Lay	Sen archt	Mil archt	Public	Lay	Sen archt	Mil archt	Public
0.000	0.000	0.000	0.000	1	1	1	1
0.000	0.002	0.045	0.069	1	1	1	0
0.000	0.000	0.000	0.000	1	1	1	1
0.000	0.005	0.004	0.000	1	1	1	1
0.004	0.128	0.932	0.192	1	0	0	0
0.000	0.102	0.000	0.000	1	0	1	1
0.000	0.000	0.000	0.000	1	1	1	1



p-value t-test mean > 0				significant at 95% conf. level			85% cl
Lay	Sen archt	Mil archt	Public	Lay	Sen archt	Mil archt	Public
0.000	0.000	0.000	0.000	1	1	1	1
0.000	0.003	0.039	0.052	1	1	1	0
0.000	0.000	0.000	0.000	1	1	1	1
0.000	0.005	0.004	0.000	1	1	1	1
0.003	0.125	0.925	0.149	1	0	0	0
0.000	0.104	0.000	0.000	1	0	1	1
0.000	0.000	0.000	0.000	1	1	1	1



APPENDIX E

Visual Preference Survey Results

E - 4 Overview narrative – VPS results by five criteria

Size Sizing as it has been alluded to, is first determined by the area of service designated in a downtown area or district and the ratio employed to address that need. The census and project survey work conducted for this dissertation demonstrates that there is a clear reduction in demand occurring. This reduction can be attributed to not only changing housing patterns with an emphasis on urbanized places with transit access, demographic and generational changes, but also by the integration of ride share and other forms of personalized mobility. In some places this can include increased bicycle use, walking and other alternate forms of transit.

The ratios employed in this dissertation that address 0.8 spaces for a one bedroom unit and 1.6 spaces for a two-bedroom unit with an average distribution of 1.2 / spaces per unit across the complex, were endorsed by all panels though each admitted that these ratios overall likely did not suffice for their current family needs, among generally single-family home dwellers.

To address sizing and capacity several strategies are being promoted by both the public and private sector. One addresses styles of parking with less focus on self-access spaces and more focus on long-term storage thru the use of tandem spaces and even mechanical stackers in double height garages where valet service makes sense. The utilization of these approaches translates to significant reductions in the ultimate physical volume of these structures since access aisles and other circulation elements which comprise as much of 50% of the built area devoted to a typical parking space is eliminated outright with spaces of these styles

Another strategy includes using public garages as overflow reservoirs to supplement parking in private garages. This approach allows for lower per unit ratios since parking for

second cars, and visitors can be addressed off site or on adjacent sites. Experts from parking authorities when interviewed spoke specifically to this subject and saw this as a clear strategy for reducing overall parking build out while maintain adequate capacity and supply.

This sharing of parking capacity is analogous to the sharing of parking in mixed-use settings, another sizing strategy, where off hour users can be accommodated by the same space otherwise assigned during the daytime. This approach works for combinations of office and residential uses but is less effective when office and retail uses co-exist.

It is clear when reviewing the VPS responses that any structure or model that incorporated mixed uses scored higher then single use structures in the area of Sizing. This includes the tests for the Ten Built Structures as well as the Infill downtown prototypes simulation and Case specific site studies. While the degree of support for mixed use structures in this category varied by panel, In the built examples all can be seen to react favorably to mixed uses in both the public and campus freestanding structures where shared parking programs were possible.

In the infill simulation mixed-use structures were favored in the Sizing criteria as well, the underground garage falling into third place which I assume indicates a sense that when "buried out of sight," parking could address any potential capacity necessary. Likewise, low-rise mixed-use scenarios scored higher in the case examples and outscored alternates that included freestanding commuter decks in the case of options 1B and 2C, The high rise and podium approaches on those sites did include freestanding single use decks

Scale The scale of parking is directly linked to an understand of the adjacent context and density of the site and district it is located in. The illustrations provided in the simulations and

case reviews consistently modeled examples of varying scales to help panel members through this somewhat abstract criterion.

Another device included in the Infill simulation was the illustration of suggested building and sky plane envelops for narrow and wide streets. There transparent brackets overlaid on the sites in question helped panel members understand when and in what way these proposed structures performed well under these criteria. Lending an appropriate scale to structures is also keyed to how individual building elements such as entries, ramps, stair towers, window openings, and overall floor heights are “read” in relationship to other elements in the façade. To the extent that all of these elements relate to a “human scale” as opposed to “highway” or “city” scale, it was mutually agreed among all panel members that these examples were successful.

In the set of Ten Built examples of parking structures, less institutional buildings with downtown motifs were ranked by all panels as the most responsive to the issue of Scale. This I am sure relates to the fact that in the replication of normal window and door openings, as well as in the use of low scale masonry materials these building gave them less of an institutional feel. The airport structure, commercial structure in Greenville and the Miami Lincoln place structure scored lowest under this criteria and I would conclude for the same reason cited above, structuralist or institutional approaches to parking structures will all fail under this criteria.

In the Infill simulation setting the underground garage, transit HUB and low-rise residential options received relatively similar assessments. The later prototypes fell well below these others in their rankings under this criteria. In the case studies again the low-rise

alternates all garnered higher scores across all panels while the high-rise options fell well below these rankings for all options and for all panels.

During the course of discussion, the question of height and the use of a consistent base height elevation for was discussed in both the Infill and case simulations. Interestingly all panels understood the importance of maintaining consistent building envelope standards in this regard.

When asked if this device was effective in the high-rise model, i.e. articulating a base element in that structure, the vast majority responded positively. Further I believe this comfort level also lead to the panel's general acceptance that the overall height of a structure was not restricted to a limit, i.e. the sky-plane could be unlimited. In only one panel was there an overwhelming response that ultimate height limits need be set. That occurred in the public official's panel, where I would have to imagine that their response had more to do with their long experience in trying to enforce consistent local zoning standards, than a specific response to this individual and particular case. In fact, several members of this panel as much as said so in subsequent conversations on the matter.

Massing Of all the criteria at interest Massing is most directly tied to the inventiveness of the design plan and the ability of individual designers to create variety in height and dimension. When well executed this quality lends interest and complexity to the design ,while avoiding a sterile or banal quality to the structure.

When surveying the results of the VPS surveys the panels clearly understood that large continuous masses were a negative, especially in a building type that tends traditionally to be massive and overwhelming in appearance.

The results from the Ten Built structures cases favored urban structures that played or matched well with their neighbors. Low scores were recorded for the airport infrastructure example, and the commercial deck in Greenville, both of which scored low in the Scale category as well.

The highest score went to the Colorado mixed use deck with a recreation component whose upper playing field and integrated bleachers represented a complete departure. Parking was buried below this level giving the structure an underground like feel even though it is in fact a freestanding deck.

Expert interviews in the development community also address this issue with an understanding that many times structures with complex sculptural qualities imply a higher cost. The question for them translates to the margin of cost for the visual impact being delivered.

Clearly the developer who re positioned the buildings on Lincoln Place in Miami understood the advantages of taking a more aggressive stance when designing the accompanying parking deck. For him this translated to a significant economic return and notoriety for the project. Panel members appeared to recognize this advantage in their scoring of that project, a moderate mid-level response across all panels, unlike other criteria for this project which evoked radically different reactions panel to panel.

In the infill simulation the Transit HUB prototype scored well again, as well as the underground garage and the low-rise residential building. Clearly the absence of all massing in a garaged structure could be considered an advantage, and the range of the forms included in the low-rise residential prototype illustrates the kind of diversity of shape and form characteristic of a well massed structure.

Visual Visual is perhaps the most subjective of all the criteria being utilized in this research study, as indicated in a prior section of this findings report, The visual quality of these structures was evaluated in a series of tests the first of which has been reported above, and looked specifically at styles of wrapped screens, facades and mixes of mater

A surprising result of the earlier analysis was the dichotomy of response from the panels. On one hand the freestanding deck treatments favored the traditional replicas built of stone and brick by a wide margin, yet the mixed-use structures favored a more contemporary composition of metal and glass materials.

Is there a particular reason for this? Perhaps the inclination to hide parking as we have come to know it and in plain sight evoked the first response, i.e. disguise these structures as something else including office and residential buildings. At the same time the mixed-use residential structures perhaps because of their overall scale and massing were allowed more flexibility in their visual manifestation.

Looking to the VPS reviews for a clue, it is clear that for the Ten Built decks favored treatment inclined towards the historic stone and brick facades illustrated in the Downers Grove, Richmond and Johnson City examples. At the same time the panels all recognized the unique aesthetic of the Colorado recreation topped deck, which is perhaps the most modernist of all the decks reviewed in this test. Interestingly the four decks designed by international firms scored lower in comparison, while the airport deck and commercial Greenville deck garnered negative responses from some panels

I was personally surprised to see that the thematic deck in Kansas City scored relatively low, though it provoked much conversation and attention across all panels. This façade was

designed by a non-architect by the way and the treatment has been widely publicized if not widely copied since its completion in the mid-1980s.

Placement The last criteria address the issue of placement. This subject includes several areas of concern. The first, relates to the overall placement of the structure and parking as a use in the city and street space, as a connector between other uses, a connector to transit and its role in defining edges and borders or landmarks in the urban space. The second, relates to the issues of movement in and around the structure, the organization and control of access points, entries, vehicle pick up and drop off zones as well as issues related to visibility, identity and way finding.

This overview of this criteria was discussed with each panel and there was a clear understanding by all members that these issues when not executed well create the potential of unsafe zones. Problems can relate to routes of movement as well as overall security and safety issues. Blind access points or unobservable zones where surveillance, either naturally or electronically, is compromised can be a fall out of bad planning approaches in this regard.

The VPS panels were, in my opinion, particularly adept in their review of this particular criteria. Their understanding of the demands placed upon these structures evolve from actual use and experience so this fact should frankly not come as surprise. This is one of the reasons to seek out panels of this type to assemble the kinds of user feedback available from these sources.

The Ten Built structures test was surprisingly consistent. The panels recognized buildings that by their placement and configuration played a larger role in defining entry and gateway in their individual settings. The Johnson City campus building as well as the Lincoln Place, Miami Beach structures scored well on this basis. This airport structure actually scored well also under these criteria. The fact that this structure serves a role with respect to the onsite airport wide monorail transit system which connects ultimately to an Amtrak rail station at its

opposite terminus, made it clear that this structure was well placed and well connected in that regard.

Structures with clear and visible access ways with separations for pedestrian movement from vehicular traffic also garner good response. A direct survey question that cited vehicular access from alleys and side streets and away from major pedestrian flows received unanimous support with 90% approval ratings from three of four panels, the other the lay users scoring this question a positive 70%.

In the infill simulation the Transit HUB and its placement in proximity to rail garner the highest response, while across the board all prototypes received positive scores. It should be stated again that these prototypes were intentionally programmed to include positive features such as the minor street and alley access points and so the panel endorsement of these approaches was somewhat pre-ordained. The lowest score in this simulation was the placement of the freestanding deck central to the block plan, and while this structure was evoked as a kind of general user reservoir for parking discussed earlier and available for local property owners, its central and prominent location was ranked low. Likewise, the high-rise mixed-use buildings was thought too prominent and there were suggestions that that structure required a more remote location from the center block in the plan. Although in this simulation its scores relative to others was moderate under these criteria.

Moving on to the case studies, the lower scored scenarios included the Newark and Metro Park high-rise alternatives. While both plans included designated pick up and drop off zones for ride share and jitney, this is perhaps one instance where the particular responses appear less criteria based then focused on an overall rejection of high-rise structures in those contexts. I should also point out that the exurban plan, 3B, that includes high-rise buildings and

the same features such as ride share, and jitney drop off zones was moderately to highly ranked under this criteria.

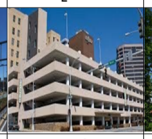
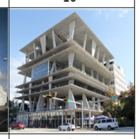
Returning to the issue of safety and surveillance a single remark stands out from a woman who was a member the lay user panel. Her remark related to visibility and observed movements, but more particularly her concern was the general lack of maintenance across the board that can create unsafe zones in these structures. Non-working elevators, stairs that were unlit or blind, and even the need to travel up sloped vehicle lanes to access upper levels at times when all of these factors converged. As I remarked earlier, these users were in fact keenly aware of the pitfalls of parking structures, the fact they were able to pull themselves away from some of these day to day issues to engage in this larger and more complex discussion was in fact admirable. At the same time ignoring some of these on the ground day to day concerns of these users would be a significant omission.

APPENDIX E

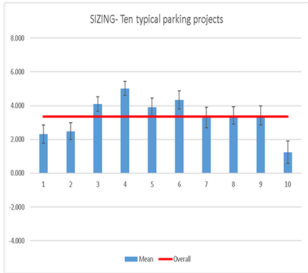
Visual Preference Survey Results

E-5 Five Criteria VPS Results – Pooled data

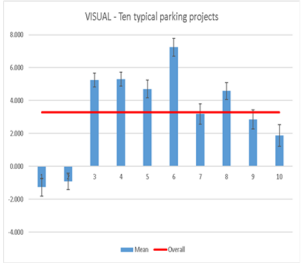
1 - Ten built models – Focus group preferences - Individual criteria scores

1	2	3	4	5	6	7	8	9	10
									
Airport infrastructure Newark	Downtown urban Greenville	Downtown suburban Downers Grove	Downtown campus Richmond	Suburban campus Johnson City	Rural campus Colorado Springs	Urban thematic Kansas City	Urban decorative Los Angeles	Urban sustainable Miami/South Beach	Brutalist / Iconic Miami/South Beach

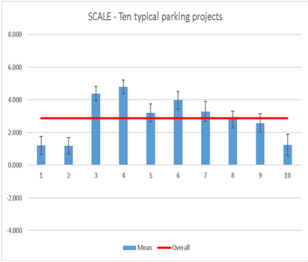
	Project	Mean	Overall	Std. Devia	95% margi	Std. Err. o	p-value t-	significant at 95% conf. level	85% cl
1	1	2.317	3.361	4.886	1.542	0.763	0.002	1	
1	2	2.488	3.361	3.641	1.149	0.569	0.000	1	
1	3	4.098	3.361	3.145	0.993	0.491	0.000	1	
1	4	5.024	3.361	3.358	1.060	0.524	0.000	1	
1	5	3.915	3.361	4.574	1.444	0.714	0.000	1	
1	6	4.341	3.361	4.503	1.421	0.703	0.000	1	
1	7	3.293	3.361	4.417	1.394	0.690	0.000	1	
1	8	3.415	3.361	4.099	1.294	0.640	0.000	1	
1	9	3.415	3.361	4.099	1.294	0.640	0.000	1	
1	10	1.250	3.361	5.746	1.838	0.908	0.088	0	



	Project	Mean	Overall	Std. Devia	95% margi	Std. Err. o	p-value t-	significant at 95% conf. level	85% cl
4	1	-1.256	3.285	4.865	1.535	0.760	0.947	0	
4	2	-0.915	3.285	5.350	1.689	0.836	0.860	0	
4	3	5.244	3.285	4.176	1.318	0.652	0.000	1	
4	4	5.293	3.285	4.033	1.273	0.630	0.000	1	
4	5	4.707	3.285	5.546	1.751	0.866	0.000	1	
4	6	7.244	3.285	4.024	1.270	0.628	0.000	1	
4	7	3.183	3.285	7.794	2.460	1.217	0.006	1	
4	8	4.585	3.285	5.005	1.580	0.782	0.000	1	
4	9	2.854	3.285	7.098	2.240	1.108	0.007	1	
4	10	1.875	3.285	7.043	2.252	1.114	0.050	0	



Project	Mean	Overall	Std. Devia	95% margi	Std. Err. o	p-value t-	significant at 95% conf. level	85% cl
1	1.220	2.877	4.441	1.402	0.694	0.043	1	
2	1.195	2.877	4.100	1.294	0.640	0.035	1	
3	4.390	2.877	3.528	1.113	0.551	0.000	1	
4	4.805	2.877	3.881	1.225	0.606	0.000	1	
5	3.207	2.877	5.125	1.618	0.800	0.000	1	
6	3.976	2.877	4.772	1.506	0.745	0.000	1	
7	3.293	2.877	4.692	1.481	0.733	0.000	1	
8	2.805	2.877	4.616	1.457	0.721	0.000	1	
9	2.585	2.877	4.505	1.422	0.704	0.000	1	
10	1.250	2.877	5.158	1.630	0.816	0.067	0	



Means of all observations

Sizing = 3.361

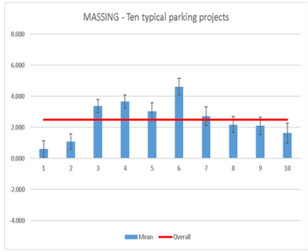
Scale = 2.877

Massing = 2.498

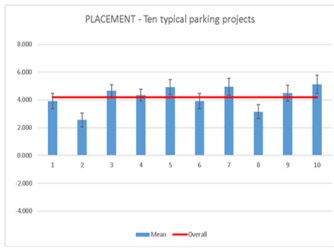
Visual = 3.285

Placement = 4.197

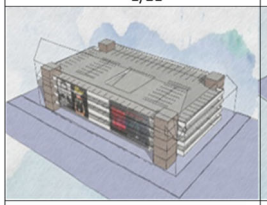
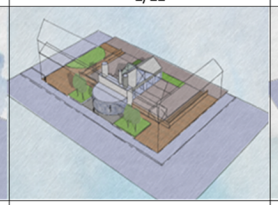
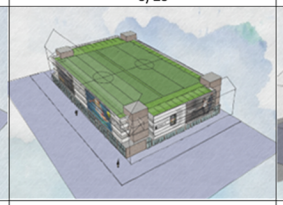
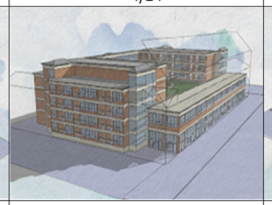
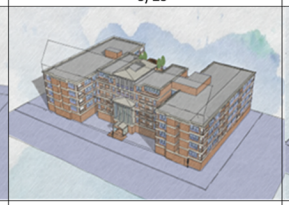
	Project	Mean	Overall	Std. Devia	95% margi	Std. Err. o	p-value t-	significant at 95% conf. level	85% cl
3	1	0.598	2.498	4.638	1.464	0.724	0.207	0	
3	2	1.073	2.498	3.996	1.261	0.624	0.047	1	
3	3	3.366	2.498	2.826	0.892	0.441	0.000	1	
3	4	3.659	2.498	3.540	1.117	0.553	0.000	1	
3	5	3.037	2.498	4.205	1.327	0.657	0.000	1	
3	6	4.622	2.498	4.211	1.329	0.658	0.000	1	
3	7	2.707	2.498	4.771	1.506	0.745	0.000	1	
3	8	2.171	2.498	4.466	1.410	0.697	0.002	1	
3	9	2.098	2.498	4.625	1.460	0.722	0.003	1	
3	10	1.625	2.498	5.592	1.788	0.884	0.037	1	



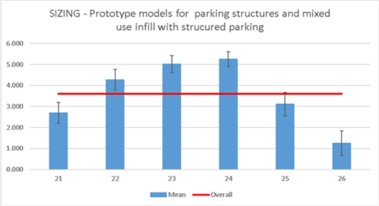
	Project	Mean	Overall	Std. Devia	95% margi	Std. Err. o	p-value t-	significant at 95% conf. level	85% cl
5	1	3.902	4.197	4.259	1.344	0.665	0.000	1	
5	2	2.561	4.197	4.348	1.372	0.679	0.000	1	
5	3	4.659	4.197	4.391	1.386	0.686	0.000	1	
5	4	4.341	4.197	3.845	1.213	0.600	0.000	1	
5	5	4.915	4.197	4.393	1.387	0.686	0.000	1	
5	6	3.902	4.197	5.864	1.851	0.916	0.000	1	
5	7	4.951	4.197	4.263	1.352	0.669	0.000	1	
5	8	3.146	4.197	4.569	1.442	0.714	0.000	1	
5	9	4.488	4.197	4.273	1.349	0.667	0.000	1	
5	10	5.125	4.197	4.158	1.330	0.657	0.000	1	



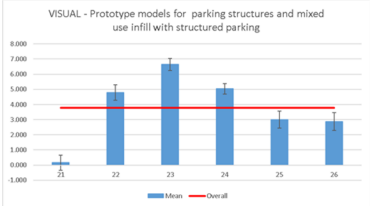
2 - Six prototypes – Focus group preferences - Individual criteria scores

1/21	2/22	3/23	4/24	5/25	6/26
					
Freestanding deck	**Underground garage**	**HUB and mixed-use freestanding**	**Low-rise Wrap-around Mixed-use**	**Mid-rise Podium residential**	**High-rise Mixed use**

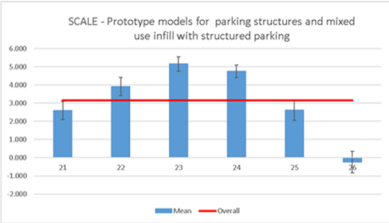
	Project	Mean	Overall	Std. Devia	95% marg	Std. Err. o	p-value t-	significant at 95% conf. level	85% cl
1	21	2.700	3.610	4.540	1.452	0.718	0.000	1	
1	22	4.268	3.610	4.061	1.282	0.634	0.000	1	
1	23	5.024	3.610	3.624	1.144	0.566	0.000	1	
1	24	5.250	3.610	3.160	1.011	0.500	0.000	1	
1	25	3.113	3.610	4.768	1.525	0.754	0.000	1	
1	26	1.250	3.610	6.127	1.959	0.969	0.102	0	



	Project	Mean	Overall	Std. Devia	95% marg	Std. Err. o	p-value t-	significant at 95% conf. level	85% cl
4	21	0.163	3.773	4.743	1.517	0.750	0.415	0	
4	22	4.793	3.773	4.558	1.439	0.712	0.000	1	
4	23	6.646	3.773	3.341	1.055	0.522	0.000	1	
4	24	5.038	3.773	2.962	0.947	0.468	0.000	1	
4	25	3.013	3.773	5.517	1.765	0.872	0.001	1	
4	26	2.888	3.773	4.150	1.327	0.656	0.000	1	



Project	Mean	Overall	Std. Devia	95% margi	Std. Err. o	p-value t-	significant at 95% conf. level	85% cl
21	2.588	3.143	3.653	1.168	0.578	0.000	1	
22	3.915	3.143	4.558	1.439	0.712	0.000	1	
23	5.159	3.143	3.153	0.995	0.492	0.000	1	
24	4.750	3.143	2.862	0.915	0.453	0.000	1	
25	2.613	3.143	4.995	1.598	0.790	0.001	1	
26	-0.238	3.143	6.156	1.969	0.973	0.596	0	



Means of all observations

Sizing = 3.610

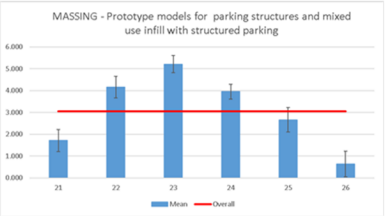
Scale = 3.143

Massing = 3.056

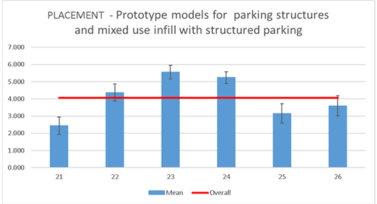
Visual = 3.588

Placement = 4.060

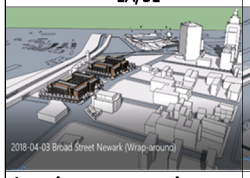
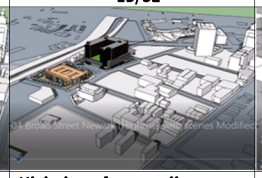
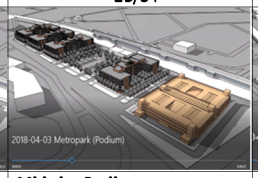
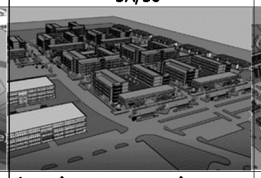
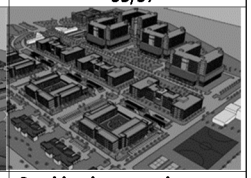
	Project	Mean	Overall	Std. Devia	95% margi	Std. Err. o	p-value t-	significant at 95% conf. level	85% cl
3	21	1.713	3.056	4.373	1.399	0.691	0.009	1	
3	22	4.159	3.056	4.712	1.487	0.736	0.000	1	
3	23	5.213	3.056	3.644	1.165	0.576	0.000	1	
3	24	3.948	3.056	2.982	0.967	0.477	0.000	1	
3	25	2.663	3.056	5.020	1.605	0.794	0.001	1	
3	26	0.688	3.056	4.907	1.569	0.776	0.208	0	



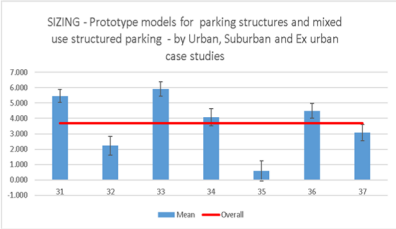
	Project	Mean	Overall	Std. Devia	95% margi	Std. Err. o	p-value t-	significant at 95% conf. level	85% cl
5	21	2.438	4.060	4.511	1.443	0.713	0.001	1	
5	22	4.363	4.060	4.722	1.510	0.747	0.000	1	
5	23	5.549	4.060	3.607	1.138	0.563	0.000	1	
5	24	5.238	4.060	3.146	1.006	0.497	0.000	1	
5	25	3.150	4.060	4.964	1.588	0.785	0.000	1	
5	26	3.588	4.060	3.937	1.259	0.622	0.000	1	



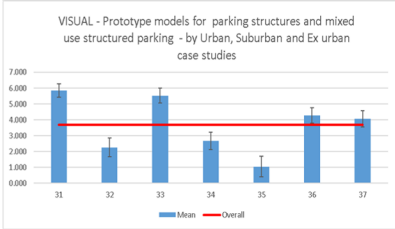
3 - Seven development options evaluated at three case locations – Focus group preferences – Individual criteria scores

1A/31	1B/32	2A/33	2B/34	2C/35	3A/36	3B/37
						
Low rise wrap-around Newark Broad St station	**High rise + freestanding Newark Broad St station**	**Low rise wrap-around Metro park Regional station**	**Mid-rise Podium + freestanding Metro park Regional station**	**Low rise + High-rise Metro park Regional station**	**Low rise wrap-around Parsippany ex urban cluster**	**Combined master plan Parsippany ex urban cluster**

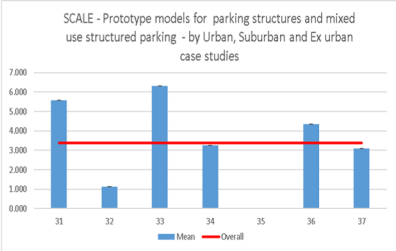
Project	Mean	Overall	Std. Devia	95% marg	Std. Err. o	p-value t-	significant at 95% conf. level	85% cl
1	31	5.450	3.688	3.959	1.266	0.626	0.000	1
1	32	2.225	3.688	5.465	1.748	0.864	0.007	1
1	33	5.910	3.688	4.481	1.452	0.717	0.000	1
1	34	4.066	3.688	4.281	1.407	0.694	0.000	1
1	35	0.590	3.688	6.133	1.988	0.982	0.276	0
1	36	4.488	3.688	4.414	1.412	0.698	0.000	1
1	37	3.088	3.688	4.995	1.597	0.790	0.000	1



Project	Mean	Overall	Std. Devia	95% marg	Std. Err. o	p-value t-	significant at 95% conf. level	85% cl
4	31	5.838	3.685	3.542	1.133	0.560	0.000	1
4	32	2.269	3.685	5.155	1.649	0.815	0.004	1
4	33	5.526	3.685	3.567	1.156	0.571	0.000	1
4	34	2.671	3.685	5.317	1.748	0.863	0.002	1
4	35	1.039	3.685	5.076	1.668	0.823	0.107	0
4	36	4.269	3.685	4.533	1.450	0.717	0.000	1
4	37	4.069	3.685	4.555	1.457	0.720	0.000	1



Project	Mean	Overall	Std. Devia	95% marg	Std. Err. o	p-value t-	significant at 95% conf. level	85% cl
31	5.575	3.389	3.325	1.064	0.526	0.000	1	
32	1.125	3.389	5.065	1.620	0.801	0.084	0	
33	6.321	3.389	4.308	1.396	0.690	0.000	1	
34	3.250	3.389	4.620	1.519	0.750	0.000	1	
35	0.013	3.389	5.981	1.939	0.958	0.495	0	
36	4.338	3.389	4.128	1.320	0.653	0.000	1	
37	3.088	3.389	4.943	1.581	0.782	0.000	1	



Means of all observations

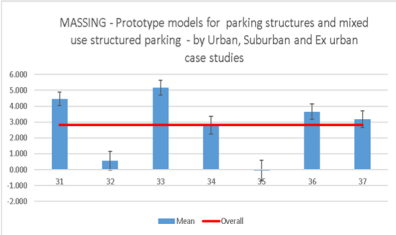
Sizing = 3.688

Scale = 3.389

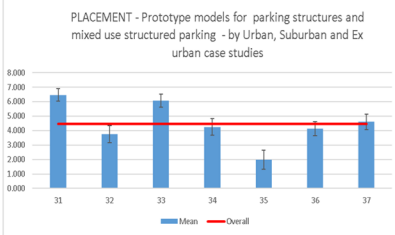
Massing = 2.824

Visual = 3.685

Placement = 4.469



Project	Mean	Overall	Std. Devia	95% marg	Std. Err. o	p-value t-	significant at 95% conf. level	85% cl
5	31	6.463	4.469	3.604	1.153	0.570	0.000	1
5	32	3.750	4.469	5.462	1.747	0.864	0.000	1
5	33	6.064	4.469	3.990	1.294	0.639	0.000	1
5	34	4.250	4.469	5.149	1.692	0.835	0.000	1
5	35	1.987	4.469	6.212	2.014	0.995	0.026	1
5	36	4.138	4.469	4.346	1.390	0.687	0.000	1
5	37	4.600	4.469	4.488	1.435	0.710	0.000	1



APPENDIX E

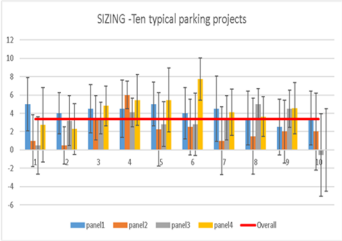
Visual Preference Survey Results

E- 6 Five Criteria VPS Results – Individual data

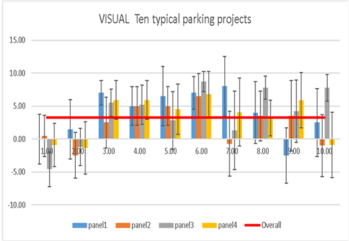
1 - Ten built models – Focus group preferences - Individual criteria scores

1	2	3	4	5	6	7	8	9	10
Airport infrastructure Newark	Downtown urban Greenville	Downtown suburban Downers Grove	Downtown campus Richmond	Suburban campus Johnson City	Rural campus Colorado Springs	Urban thematic Kansas City	Urban decorative Los Angeles	Urban sustainable Miami/South Beach	Brutalist / Iconic Miami/South Beach

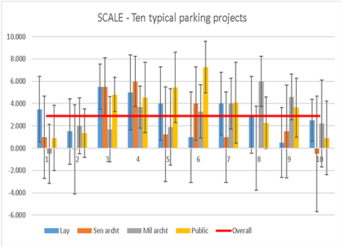
	Mean					p-value t-test mean >0				significant at 95% conf. level			85% CL	
Project	Lay	Senior	Mill	Public	Overall	Lay	Senior	Mill	Public	Lay	Senior	Mill	Public	
1.00	5.00	1.00	0.50	2.73	3.36	0.00	0.22	0.36	0.00	1	0	0	0	
2.00	4.00	0.50	3.20	2.27	3.36	0.00	0.30	0.01	0.05	1	0	1	1	
3.00	4.50	3.50	3.50	4.82	3.36	0.00	0.00	0.00	0.00	1	1	1	1	
4.00	4.50	6.00	4.10	5.45	3.36	0.00	0.00	0.00	0.00	1	1	1	1	
5.00	5.00	2.25	2.80	5.45	3.36	0.00	0.12	0.01	0.00	1	0	1	1	
6.00	4.00	2.50	2.80	7.73	3.36	0.01	0.05	0.05	0.00	1	1	1	1	
7.00	4.50	1.00	3.50	4.09	3.36	0.01	0.28	0.00	0.00	1	0	1	1	
8.00	3.50	1.50	5.00	3.64	3.36	0.01	0.22	0.00	0.00	1	0	1	1	
9.00	2.50	2.00	4.90	4.55	3.36	0.05	0.11	0.00	0.00	1	0	1	1	
10.00	3.50	2.00	-0.56	0.00	3.36	0.01	0.15	0.61	0.50	1	0	0	0	



	Mean					p-value t-test mean >0				significant at 95% conf. level			85% CL	
Project	Lay	Senior	Mill	Public	Overall	Lay	Senior	Mill	Public	Lay	Senior	Mill	Public	
1	-0.05	0.50	-4.60	-0.91	3.28	0.51	0.36	1.00	0.72	0	0	0	0	
2	1.45	-2.50	-1.20	-1.36	3.28	0.24	0.93	0.82	0.77	0	0	0	0	
3	7.00	2.50	5.50	5.91	3.28	0.00	0.09	0.00	0.00	1	0	1	1	
4	5.00	5.00	5.20	5.91	3.28	0.00	0.00	0.00	0.00	1	1	1	1	
5	6.50	5.00	2.80	4.55	3.28	0.00	0.00	0.09	0.01	1	1	0	1	
6	7.00	6.50	8.70	6.82	3.28	0.00	0.00	0.00	0.00	1	1	1	1	
7	8.00	-0.75	1.30	4.09	3.28	0.00	0.63	0.32	0.05	1	0	0	0	
8	4.00	3.50	7.80	3.18	3.28	0.04	0.03	0.00	0.01	1	1	1	1	
9	-2.50	3.50	4.20	5.91	3.28	0.89	0.09	0.04	0.01	0	0	1	1	
10	2.50	-1.00	7.78	-0.91	3.28	0.15	0.68	0.00	0.65	0	0	1	0	



	Mean					p-value t-test mean >0				significant at 95% conf. level			85% CL	
Project	Lay	Senior	Mill	Public	Overall	Lay	Senior	Mill	Public	Lay	Senior	Mill	Public	
1	3.50	1.00	-0.50	0.91	2.88	0.01	0.28	0.66	0.25	1	0	0	0	
2	1.50	-0.10	2.00	1.36	2.88	0.14	0.52	0.05	0.10	0	0	0	0	
3	5.50	5.50	1.70	4.82	2.88	0.00	0.00	0.11	0.00	1	1	0	1	
4	5.00	6.00	3.70	4.55	2.88	0.00	0.00	0.00	0.00	1	1	1	1	
5	4.00	1.25	1.90	5.45	2.88	0.01	0.26	0.12	0.00	1	0	0	1	
6	1.00	4.00	3.30	7.27	2.88	0.30	0.01	0.01	0.00	0	1	1	1	
7	4.00	1.00	4.00	4.09	2.88	0.01	0.30	0.00	0.02	1	0	1	1	
8	3.00	0.00	6.00	2.27	2.88	0.04	0.50	0.00	0.03	1	0	1	1	
9	0.50	1.50	4.60	3.64	2.88	0.36	0.22	0.00	0.01	0	0	1	1	
10	2.50	-0.50	2.22	0.91	2.88	0.01	0.58	0.11	0.28	1	0	0	0	



Means of all observations

Sizing = 3.36

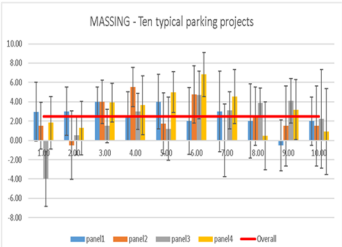
Scale =2.88

Massing = 2.50

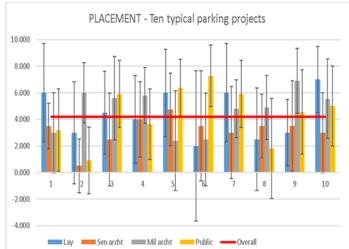
Visual = 3.28

Placement = 4.20

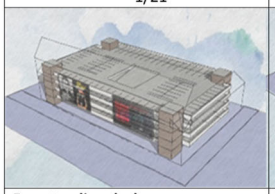
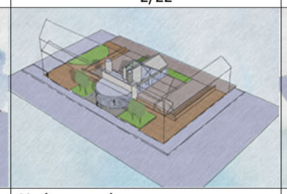
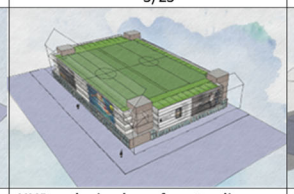
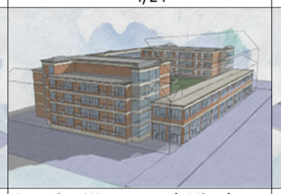
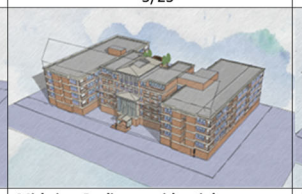
	Mean					p-value t-test mean >0				significant at 95% conf. level			85% CL	
Project	Lay	Senior	Mill	Public	Overall	Lay	Senior	Mill	Public	Lay	Senior	Mill	Public	
1.00	2.95	1.50	-4.00	1.82	2.50	0.03	0.10	0.99	0.08	1	0	0	0	
2.00	3.00	-0.50	0.50	1.27	2.50	0.01	0.62	0.30	0.16	1	0	0	0	
3.00	4.00	4.00	1.50	3.91	2.50	0.00	0.00	0.04	0.00	1	1	1	1	
4.00	2.50	5.50	3.00	3.64	2.50	0.03	0.00	0.00	0.01	1	1	1	1	
5.00	4.00	1.75	1.20	5.00	2.50	0.01	0.12	0.21	0.00	1	0	0	1	
6.00	2.00	4.75	4.70	6.82	2.50	0.11	0.00	0.00	0.00	0	1	1	1	
7.00	3.00	0.00	3.10	4.55	2.50	0.07	0.50	0.00	0.00	0	0	1	1	
8.00	2.00	2.50	3.90	0.45	2.50	0.13	0.05	0.00	0.39	0	1	1	0	
9.00	-0.50	1.50	4.10	3.18	2.50	0.66	0.22	0.00	0.02	0	0	1	1	
10.00	2.00	1.50	2.22	0.91	2.50	0.05	0.22	0.17	0.33	0	0	0	0	



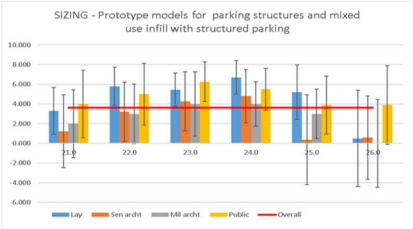
	Mean					p-value t-test mean >0				significant at 95% conf. level			85% CL	
Project	Lay	Senior	Mill	Public	Overall	Lay	Senior	Mill	Public	Lay	Senior	Mill	Public	
1.00	6.00	3.50	3.00	3.18	4.20	0.00	0.00	0.03	0.02	1	1	1	1	
2.00	3.00	0.50	6.00	0.91	4.20	0.06	0.30	0.00	0.22	0	0	1	0	
3.00	4.50	2.50	5.60	5.91	4.20	0.00	0.07	0.00	0.00	1	0	1	1	
4.00	4.00	4.00	5.80	3.64	4.20	0.01	0.01	0.00	0.01	1	1	1	1	
5.00	6.00	4.75	2.40	6.36	4.20	0.00	0.00	0.09	0.00	1	1	0	1	
6.00	2.00	3.50	2.50	7.27	4.20	0.22	0.04	0.07	0.00	0	1	0	1	
7.00	6.00	3.00	4.80	5.91	4.20	0.00	0.04	0.00	0.00	1	1	1	1	
8.00	2.50	3.50	4.90	1.82	4.20	0.09	0.00	0.00	0.15	0	1	1	0	
9.00	3.00	3.50	6.90	4.55	4.20	0.01	0.02	0.00	0.00	1	1	1	1	
10.00	7.00	3.00	5.56	5.00	4.20	0.00	0.03	0.00	0.00	1	1	1	1	



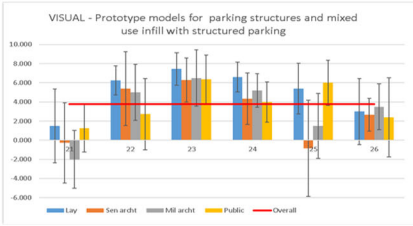
2 - Six prototypes – Focus group preferences - Individual criteria scores

1/21	2/22	3/23	4/24	5/25	6/26
					
Freestanding deck	Underground garage	HUB and mixed-use freestanding	Low-rise Wrap-around Mixed-use	Mid-rise Podium residential	High-rise Mixed use

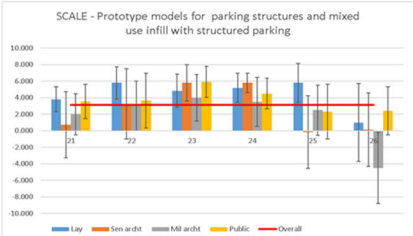
	Mean					p-value t-test mean > 0				significant at 95% conf. level				85% CL
Project	Lay	Senior	Mill	Public	Overall	Lay	Senior	Mill	Public	Lay	Senior	Mill	Public	
1.00	5.00	1.00	0.50	2.73	3.36	0.00	0.22	0.36	0.08	1	0	0	0	0
2.00	4.00	0.50	3.20	2.27	3.36	0.00	0.30	0.01	0.05	1	0	1	1	1
3.00	4.50	3.50	3.50	4.82	3.36	0.00	0.00	0.00	0.00	1	1	1	1	1
4.00	4.50	6.00	4.10	5.45	3.36	0.00	0.00	0.00	0.00	1	1	1	1	1
5.00	5.00	2.25	2.80	5.45	3.36	0.00	0.12	0.01	0.00	1	0	1	1	1
6.00	4.00	2.50	2.80	7.73	3.36	0.01	0.05	0.05	0.00	1	1	1	1	1
7.00	4.50	1.00	3.50	4.09	3.36	0.01	0.28	0.00	0.00	1	0	1	1	1
8.00	3.50	1.50	5.00	3.64	3.36	0.01	0.22	0.00	0.00	1	0	1	1	1
9.00	2.50	2.00	4.50	4.55	3.36	0.05	0.11	0.00	0.00	1	0	1	1	1
10.00	3.50	2.00	-0.56	0.00	3.36	0.01	0.15	0.61	0.50	1	0	0	0	0



	Mean					p-value t-test mean > 0				significant at 95% conf. level				85% CL
Project	Lay	Senior	Mill	Public	Overall	Lay	Senior	Mill	Public	Lay	Senior	Mill	Public	
21	1.50	-0.28	-2.00	1.27	3.77	0.20	0.56	0.92	0.14	0	0	0	0	0
22	6.25	5.40	5.00	2.73	3.77	0.00	0.01	0.00	0.07	1	1	1	1	0
23	7.45	6.30	6.50	6.36	3.77	0.00	0.00	0.00	0.00	1	1	1	1	1
24	6.60	4.35	5.20	4.00	3.77	0.00	0.00	0.00	0.00	1	1	1	1	1
25	5.40	-0.65	1.50	6.00	3.77	0.00	0.64	0.17	0.00	1	0	0	1	1
26	3.00	2.65	3.50	2.40	3.77	0.04	0.00	0.00	0.11	1	1	1	1	0



	Mean					p-value t-test mean > 0				significant at 95% conf. level				85% CL
Project	Lay	Senior	Mill	Public	Overall	Lay	Senior	Mill	Public	Lay	Senior	Mill	Public	
21	3.80	0.72	2.00	3.55	3.14	0.00	0.34	0.05	0.00	1	0	0	1	1
22	5.80	3.25	3.00	3.64	3.14	0.00	0.06	0.03	0.02	1	0	1	1	1
23	4.85	5.80	4.00	5.91	3.14	0.00	0.00	0.01	0.00	1	1	1	1	1
24	5.20	5.80	3.50	4.50	3.14	0.00	0.00	0.01	0.00	1	1	1	1	1
25	5.80	-0.15	2.50	2.36	3.14	0.00	0.53	0.05	0.07	1	0	1	1	0
26	1.00	0.15	-4.50	2.40	3.14	0.32	0.47	0.98	0.05	0	0	0	0	1



Means of all observations

Sizing = 3.36

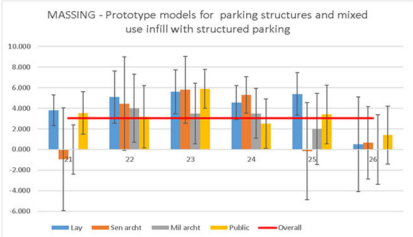
Scale = 3.14

Massing = 3.06

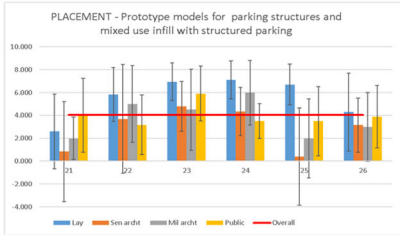
Visual = 3.77

Placement = 4.06

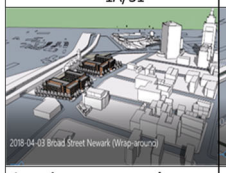
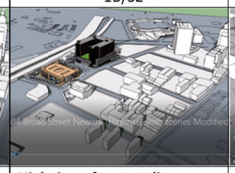
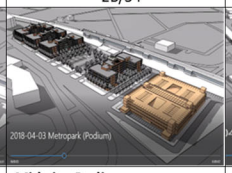
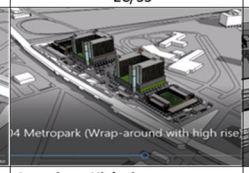
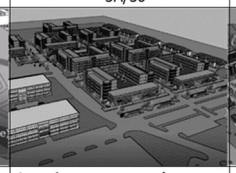
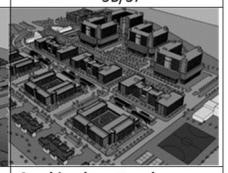
	Mean					p-value t-test mean > 0				significant at 95% conf. level				85% CL
Project	Lay	Senior	Mill	Public	Overall	Lay	Senior	Mill	Public	Lay	Senior	Mill	Public	
21.00	3.80	-0.94	0.00	3.55	3.06	0.00	0.66	0.50	0.00	1	0	0	1	1
22.00	5.10	4.45	4.00	3.18	3.06	0.00	0.03	0.01	0.02	1	1	1	1	1
23.00	5.61	5.80	3.50	5.91	3.06	0.00	0.00	0.01	0.00	1	1	1	1	1
24.00	4.56	5.30	3.50	2.50	3.06	0.00	0.00	0.00	0.02	1	1	1	1	1
25.00	5.40	-0.15	2.00	3.40	3.06	0.00	0.53	0.11	0.01	1	0	0	1	1
26.00	0.50	0.65	0.00	1.40	3.06	0.41	0.34	0.50	0.14	0	0	0	0	0



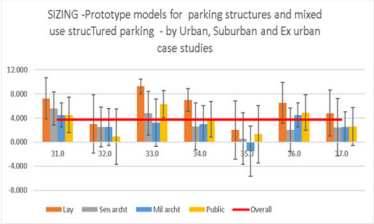
	Mean									significant at 95% conf. level				85% CL
Project	Lay	Senior	Mill	Public	Overall	Lay	Senior	Mill	Public	Lay	Senior	Mill	Public	
21.00	2.60	0.83	2.00	4.00	4.06	0.05	0.34	0.02	0.01	0	0	1	1	
22.00	5.83	3.70	5.00	3.18	4.06	0.00	0.06	0.00	0.01	1	0	1	1	
23.00	6.95	4.80	4.50	5.91	4.06	0.00	0.00	0.01	0.00	1	1	1	1	
24.00	7.10	4.35	6.00	3.50	4.06	0.00	0.00	0.00	0.00	1	1	1	1	
25.00	6.70	0.40	2.00	3.50	4.06	0.00	0.42	0.11	0.01	1	0	0	1	
26.00	4.30	3.15	3.00	3.90	4.06	0.01	0.01	0.03	0.01	1	1	1	1	



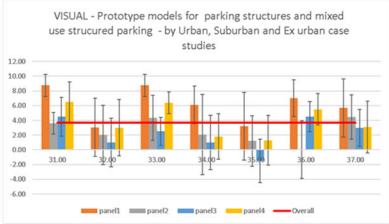
3 - Seven development options evaluated at three case locations – Focus group preferences – Individual criteria scores

1A/31	1B/32	2A/33	2B/34	2C/35	3A/36	3B/37
						
Low rise wrap-around Newark Broad St station	**High rise + freestanding Newark Broad St station**	**Low rise wrap-around Metro park Regional station**	**Mid-rise Podium + freestanding Metro park Regional station**	**Low rise + High-rise Metro park Regional station**	**Low rise wrap-around Parsippany ex urban cluster**	**Combined master plan Parsippany ex urban cluster**

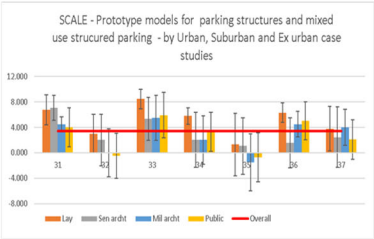
	Mean					p-value t-test mean > 0				significant at 95% conf. level			85% CL
Project	Lay	Senior	Mill	Public	Overall	Lay	Senior	Mill	Public	Lay	Senior	Mill	Public
31.00	7.25	5.55	4.50	4.50	3.69	0.00	0.00	0.00	0.00	1	1	1	1
32.00	3.00	2.50	2.50	0.90	3.69	0.10	0.06	0.05	0.34	0	0	1	0
33.00	9.25	4.78	3.20	6.30	3.69	0.00	0.01	0.05	0.00	1	1	1	1
34.00	7.00	2.61	3.00	3.80	3.69	0.00	0.08	0.03	0.01	1	0	1	1
35.00	2.00	0.56	-1.50	1.30	3.69	0.19	0.39	0.78	0.28	0	0	0	0
36.00	6.50	2.05	4.50	4.90	3.69	0.00	0.12	0.00	0.00	1	0	1	1
37.00	4.80	2.45	2.50	2.60	3.69	0.01	0.14	0.03	0.05	1	0	1	1



	Mean					p-value t-test mean > 0				significant at 95% conf. level			85% CL
Project	Lay	Senior	Mill	Public	Overall	Lay	Senior	Mill	Public	Lay	Senior	Mill	Public
31	8.75	3.60	4.50	6.50	3.69	0.00	0.00	0.00	0.00	1	1	1	1
32	3.05	2.00	1.00	3.00	3.69	0.06	0.15	0.25	0.06	0	0	0	0
33	8.75	4.33	2.50	6.40	3.69	0.00	0.01	0.01	0.00	1	1	1	1
34	6.11	2.06	1.00	1.80	3.69	0.00	0.21	0.28	0.11	1	0	0	0
35	3.20	1.19	-1.50	1.30	3.69	0.07	0.22	0.86	0.20	0	0	0	0
36	7.00	0.05	4.50	5.50	3.69	0.00	0.49	0.00	0.00	1	0	1	1
37	5.70	4.45	3.00	3.10	3.69	0.00	0.00	0.01	0.04	1	1	1	1



	Mean					p-value t-test mean > 0				significant at 95% conf. level			85% CL
Project	Lay	Senior	Mill	Public	Overall	Lay	Senior	Mill	Public	Lay	Senior	Mill	Public
31	6.75	7.05	4.50	4.00	3.39	0.00	0.00	0.00	0.01	1	1	1	1
32	3.00	2.00	0.00	-0.50	3.39	0.03	0.15	0.50	0.62	1	0	0	0
33	8.45	5.33	5.50	5.90	3.39	0.00	0.00	0.00	0.00	1	1	1	1
34	5.78	2.06	2.00	3.30	3.39	0.00	0.15	0.13	0.02	1	0	0	1
35	1.30	1.06	-1.50	-0.70	3.39	0.28	0.30	0.77	0.65	0	0	0	0
36	6.30	1.55	4.50	5.00	3.39	0.00	0.20	0.00	0.00	1	0	1	1
37	3.80	2.45	4.00	2.10	3.39	0.02	0.14	0.01	0.08	1	0	1	0



Means of all observations

Sizing = 3.688

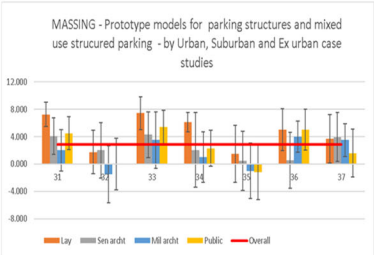
Scale = 3.389

Massing = 2.824

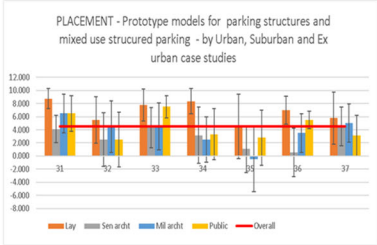
Visual = 3.685

Placement = 4.469

	Mean					p-value t-test mean > 0				significant at 95% conf. level			85% CL
Project	Lay	Senior	Mill	Public	Overall	Lay	Senior	Mill	Public	Lay	Senior	Mill	Public
31.00	7.25	4.10	2.00	4.50	2.82	0.00	0.00	0.08	0.00	1	1	0	1
32.00	1.75	2.00	-1.50	0.00	2.82	0.12	0.15	0.78	0.50	0	0	0	0
33.00	7.45	4.28	3.50	5.40	2.82	0.00	0.01	0.04	0.00	1	1	1	1
34.00	6.11	2.06	1.00	2.30	2.82	0.00	0.21	0.28	0.04	1	0	0	1
35.00	1.50	0.50	-1.00	-1.20	2.82	0.22	0.40	0.70	0.74	0	0	0	0
36.00	5.05	0.55	4.00	5.00	2.82	0.00	0.38	0.00	0.00	1	0	1	1
37.00	3.67	3.95	3.50	1.60	2.82	0.02	0.02	0.00	0.16	1	1	1	0



	Mean									significant at 95% conf. level			85% CL
Project	Lay	Senior	Mill	Public	Overall	Lay	Senior	Mill	Public	Lay	Senior	Mill	Public
31.00	8.75	4.10	6.50	6.50	4.47	0.00	0.00	0.00	0.00	1	1	1	1
32.00	5.50	2.50	4.50	2.50	4.47	0.00	0.10	0.01	0.11	1	0	1	0
33.00	7.75	4.33	4.50	7.50	4.47	0.00	0.01	0.01	0.00	1	1	1	1
34.00	8.33	3.17	2.50	3.30	4.47	0.00	0.06	0.07	0.04	1	0	0	1
35.00	4.50	1.06	-0.50	2.80	4.47	0.03	0.26	0.59	0.08	1	0	0	0
36.00	7.00	0.55	3.50	5.50	4.47	0.00	0.37	0.01	0.00	1	0	1	1
37.00	5.80	4.50	5.00	3.10	4.47	0.00	0.00	0.00	0.02	1	1	1	1



APPENDIX F

Binary questions – Future trends

F – 1 Binary questions – Matrix of results

Sizing, automobile and parking use. **0.00% = Fails to meet >.5 to <.5% CL**

Development related issues

A Do you favor public parking built to support existing private holdings ? (101)

Lay persons	Architects seniors	Architects M Millennials	Board members	Mean of all groups
50.0%	90.0%	80.0%	81.8%	75.6%

B Do you favor public parking built to support new owners of private holdings ? (102)

Lay persons	Architects seniors	Architects Millennials	Board members	Mean of all groups
55.6%	80.0%	40.0%	27.3%	50.0%

C Do you favor investing in visual and phone app. based inventory system to maximize usability and minimize overbuilding of parking? (103)

Lay persons	Architects seniors	Architects Millennials	Board members	Mean of all groups
70.0%	88.9%	90.0%	63.6%	77.5%

D Do you favor increasing capacity of parking to eliminate all if not most on street parking?(104)

Lay persons	Architects seniors	Architects Millennials	Board members	Mean of all groups
10.0%	33.3%	50.0%	81.8%	45%

E Do you favor a mix of tandem spaces in private mixed-use garages? (105)

Lay persons	Architects seniors	Architects Millennials	Board members	Mean of all groups
30.0%	60.0%	90.0%	72.7%	63.4%

F Do you favor a mix of tandem spaces in public garages? (106)

Lay persons	Architects seniors	Architects Millennials	Board members	Mean of all groups
30.0%	20.0%	20.0%	0.0%	17.1%

Parking ratios and standards

G Are the parking ratios proposed for these studies acceptable ? (107)

(0.8/ 1 bedroom, 1.2 / 2 bedroom)

Lay persons	Architects seniors	Architects Millennials	Board members	Mean of all groups
70.0%	80.0%	60.0%	45.5%	63.4%

H Do these parking ratios meet your family's needs? (108)

Lay persons	Architects seniors	Architects Millennials	Board members	Mean of all groups
60.0%	40.0%	50.0%	36.4%	46.3%

I Does access to public transportation impact your responses to 1G and 1H above?(112)

Lay persons	Architects seniors	Architects Millennials	Board members	Mean of all groups
70.0%	100.00%	80.0%	18.2%	65.9%

J Number of private vehicles in your family?

Lay persons	Architects seniors	Architects Millennials	Board members	Mean of all groups
2.10	1.89	2.60	3.10	2.43

K Will your need for parking decrease with age? (110)

Lay persons	Architects seniors	Architects Millennials	Board members	Mean of all groups
44.4%	80.0%	70.0%	72.7%	67.5%

Housing choices, urban living and commuter patterns

L Can you foresee relocating to an urbanized setting depicted in these studies? (116)

Lay persons	Architects seniors	Architects Millennials	Board members	Mean of all groups
20.0%	33.3%	50.0%	54.4%	40.0%

M Current living situation 1=Single family, 2=Tn House , 3=Apt Sub. or Dntown, 4=Other

Lay persons	Architects seniors	Architects Millennials	Board members	Mean of all groups
1.60	2.00	2.10	1.10	1.70

N Future living situation 1=Single family, 2=Tn House , 3=Apt Sub. or Dntown, 4=Other

2.00	2.13	1.30	2.20	1.91

O Will work from home or co-work situations replace commuting to work? (119)1.10

Lay persons	Architects seniors	Architects Millennials	Board members	Mean of all groups
80.0%	75.0%	80.0%	45.5%	69.2%

P Do you commute to work at least three days a week? (120)

Lay persons	Architects seniors	Architects Millennials	Board members	Mean of all groups
90.0%	89.0%	100.0%	100.0%	84.6%

Q Do you work from home at least part of the week? (121)

Lay persons	Architects seniors	Architects Millennials	Board members	Mean of all groups
10.0%	66.7%	10.0%	20.0%	25.6%

Binary questions by area of interest

2 Scale and massing

Development and street issues

A Do you feel a low-rise active frontage up is an important feature ? (201)

Lay persons	Architects seniors	Architects Millennials	Board members	Mean of all groups
100.0%	100.0%	90.0%	100.0%	97.4%

B Do feel a high-rise active frontage is an important feature? (202)

Lay persons	Architects seniors	Architects Millennials	Board members	Mean of all groups
80.0%	100.0%	100.0%	90.0%	92.3%

C Is the fact that the mixed-use models incorporate private open space a problem? (203)

Lay persons	Architects seniors	Architects Millennials	Board members	Mean of all groups
10.0%	40.0%	40.0%	10.0%	25.0%

Massing, setback and articulated elements of the structure.

D Are all models appropriate in the zone? (204)

Lay persons	Architects seniors	Architects Millennials	Board members	Mean of all groups
90.0%	70.0%	40.0%	70.0%	67.5%

E Is addition setback for the podium model an important feature? (205)

Lay persons	Architects seniors	Architects Millennials	Board members	Mean of all groups
90.0%	80.0%	60.0%	80.0%	77.5%

F Is the articulation of the base height in the high-rise model an important feature? (206)

Lay persons	Architects seniors	Architects Millennials	Board members	Mean of all groups
70.0%	77.8%	60.0%	80.0%	71.8%

Height

G Can models exceed height limits and building envelopes in the zone ? (207)

Lay persons	Architects seniors	Architects Millennials	Board members	Mean of all groups
60.0%	70.0%	60.0%	72.7%	65.9%

H Is the fact that the high-rise structure violates the sky plane envelope an issue? (208)

Lay personas	Architects seniors	Architects Millennials	Board members	Mean of all groups
60.0%	40.0%	60.0%	70.0%	57.5%

Binary questions and questions by area of interest

3 Visual

A Ranking of façade treatments for freestanding parking decks

Treatment	Lay persons	Senior architects	Millennial architects	Public officials	Mean of all groups
Treat `1 Traditional reductive facade	4.90	4.00	1.00	7.40	4.33
Treat 2 Screen with graphic content	5.70	1.15	3.50	0.00	2.65
Treat 3 Screen with sustainable treatment	-0.50	4.95	4.00	2.40	2.71
Treat 4 Screen with LED decorative treatment	3.40	3.20	5.00	2.20	3.45
Treat 5 Decorative thematic overlay	5.20	-2.65	-1.20	2.00	0.84
Treat 6 Brutalist / structuralist treatment	0.60	-2.22	2.00	-2.50	0.49

B Ranking of façade treatments for mixed use structures with integrated decks

Treatment	Lay panel	Senior architects	Millennial architects	Public officials	Mean of all groups
Treat `1 Wood and siding	4.30	-0.55	2.00	2.00	1.94
Treat 2 Stone and brick	8.20	2.15	1.70	6.60	4.66
Treat 3 Glass and metal	7.50	5.05	5.20	6.00	5.94
Treat 4 Glass contemporary	3.20	4.55	3.70	2.50	3.49

Binary questions and questions by area of interest

4 Placement

Access and use issues

A Do you favor access to decks from minor streets and alleys vs major streets? (401)

Lay persons	Architects seniors	Architects Millennials	Board members	Mean of all groups
70.0%	90.0%	90.0%	90.0%	85.4%

B Do you favor adding capacity in parking decks to eliminate all if not most on street parking for the benefit of uber and jitney drop off and pick up? (104)

Lay persons	Architects seniors	Architects Millennials	Board members	Mean of all groups
10.0%	33.0%	50.0%	81.8%	45.0%

Binary questions and questions by area of interest

5 Economics

A As a taxpayer would you accept a 100% increase in the cost of parking in order to build a garage vs a freestanding structure (20K vs 40K per space)? (601)

Lay persons	Architects seniors	Architects Millennials	Board members	Mean of all groups
20.0%	77.8%	60.0%	63.6%	55.0%

B As a taxpayer would you accept a further 50% increase in the cost of parking in order to build an automated garage (40K vs 60K per space)? (602)

Lay persons	Architects seniors	Architects Millennials	Board members	Mean of all groups
20.0%	10.0%	50.0%	0.00%	19.5%

C As a taxpayer would you accept a 20% increase in the cost of parking in order to build a recreation deck over a freestanding garage to extend its daily use and utility (20K vs 24K per space) ? (603)

Lay persons	Architects seniors	Architects Millennials	Board members	Mean of all groups
80.0%	80.0%	100.0%	90.9%	87.8%

D As a taxpayer would you accept the cost of overbuilding deck capacity in order to eliminate all if not most on street parking with the associated benefits of open space and increased sideway and pedestrian space in the street? (604)

Lay persons	Architects seniors	Architects Millennials	Board members	Mean of all groups
10.0%	33.3%	50.0%	81.8%	45.0%

E As a taxpayer would you accept the cost of a phone app. based town wide signal and inventory system to enhance capacity and utilization rates so as to avoid having to overbuild future parking.? (605)

Lay persons	Architects seniors	Architects Millennials	Board members	Mean of all groups
70.0%	88.9%	90.0%	63.6%	77.5%

Binary questions and questions by area of interest

6 Future trends related to transit and alternative mobility systems

A Based on the adoption of ride share and autonomous jitneys will parking lots and structures be significantly eliminated? (501)

Lay persons	Architects seniors	Architects Millennials	Board members	Mean of all groups
10.0%	40.0%	60.0%	27.3%	34.1%

B Will rideshare and autonomous jitneys replace the need for private vehicles? (113)

Lay personas	Architects seniors	Architects Millennials	Board members	Mean of all groups
40.0%	20.0%	20.0%	27.3%	26.8%

C Will overall demand for private vehicles reduce along with parking demand? (111)

Lay persons	Architects seniors	Architects Millennials	Board members	Mean of all groups
70.0%	55.6%	40.0%	45.5%	52.5%

D Can you foresee replacing your need for a private vehicle with ride share and public transportation? (114)

Lay persons	Architects seniors	Architects Millennials	Board members	Mean of all groups
20.0%	50.0%	30.0%	45.5%	36.6%

E Can you foresee reducing your auto dependency to a single vehicle or less? (115)

Lay persons	Architects seniors	Architects Millennials	Board members	Mean of all groups
50.0%	44.4%	30.0%	54.5%	45.0%

APPENDIX F

Binary questions – Future trends

F - 2 Binary questions – Statistical analysis pooled results

Binary responses – Pooled analysis

Sizing and automoble and parking use								
RQ 1	c1			proportion	95% margin of error	Std. Err.	P-value for testing proportion > 0.5	P-value for testing proportion < 0.5
		Favor public parking built to support existing private holdings	101	0.756098	0.131448	0.067066	0.00051968	0.99948032
		Favor public parking built to support new private development	102	0.5	0.154949	0.079057	0.5	0.5
		Favor Investing in visual and phone app. based inventory system?	103	0.775	0.129408	0.066026	0.00025211	0.99974789
		Favor increase capacity to eliminate all if not most on street parkng?	104	0.45	0.154172	0.078661	0.73645537	0.26354463
		Favor mix of tandem spaces in private mixed use ?	105	0.634146	0.147436	0.075224	0.04290639	0.95709361
		Favor mix tandem spaces in public structures ?	106	0.170732	0.115176	0.058764	0.9999876	0.0000124
		RQ2 Future trends						
		1 Parkign ratios depicted						
		Parking ratios. (0.8/ 1 bedroom, 1.2 / 2 bedroom) ?	107	0.634146	0.147436	0.075224	0.04290639	0.95709361
		Parking ratios support your family's needs ?	108	0.463415	0.152637	0.077878	0.68029407	0.31970593
		2 Current and future ownership expectations						
		Will your need for parking decrease with age?	110	0.675	0.145148	0.074057	0.01342835	0.98657165
		Will overall demand for private vehicles reduce along with parking demand?	111	0.525	0.154755	0.078958	0.37591482	0.62408518
		Does presense of public transportation change your responses to 1F & 1G ?	112	0.658537	0.14515	0.074058	0.02116511	0.97883489
		Will ride share and autonomous jitneys replace the need for private vehicles?	113	0.268293	0.135622	0.069196	0.99849787	0.00150213
		Can you foresee replacing your need for a private vehicle with ride share and public trar	114	0.365854	0.147436	0.075224	0.95709361	0.04290639
		Can you foresee reducing your auto dependency to a single vehicle or less?	115	0.45	0.154172	0.078661	0.73645537	0.26354463
		3 Housing and living patterns						
		Can you foresee relocating to an urbanized setting depicted in these studies?	116	0.4	0.151818	0.07746	0.89704839	0.10295161
		4 Commuting and work from home						
		Will work from home and co work settings replace the need to commute to work?	119	0.692308	0.144852	0.073905	0.00815459	0.99184541
		Commute to work at last three days a week?	120	0.846154	0.113236	0.057774	7.68E-06	0.99999232
		Currently work from home at least part of the week?	121	0.25641	0.137041	0.06992	0.99882664	0.00117336
		Scale and Massing						
		RQ 1 Current practice						
		1 Proptypes - Street and open space issues						
		Low rise active frontage up is an important feature?	201	0.974359	0.049607	0.02531	1.56E-09	1
		High rise active frontage is an important feature?	202	0.923077	0.08363	0.042669	6.31E-08	0.99999994
		Mixed use models incorporate private open space, is this a problem?	203	0.25	0.13419	0.068465	0.9992173	0.0007827
		2 Prototype and attributes						
		All three models appropriately sited in zone?	204	0.675	0.145148	0.074057	0.01342835	0.98657165
		Podium additional front setback is an important feature?	205	0.775	0.129408	0.066026	0.00025211	0.99974789
		High rise provides articulated base height an important gesture?	206	0.717949	0.14123	0.072057	0.00324265	0.99675735
		3 Height limits						
		Can height of structures exceed envelope limits?	207	0.658537	0.14515	0.074058	0.02116511	0.97883489
		High rise violates the sky plane, is this problematic?	208	0.575	0.153196	0.078162	0.17139086	0.82860914
		Placement						
stderr_agg_all		**RQ 1 Current practuce**						
		Access restricted to minor streets and alleys?	401	0.853659	0.108189	0.055199	2.96E-06	0.99999704
		Increase capacity to eliminate all if not most on street parkng?	402	0.45	0.154172	0.078661	0.73645537	0.26354463
		All						
		RQ2 Future trends						
		Based on the above will parking lots and structures be significantly eliminated?	501	0.341463	0.14515	0.074058	0.97883489	0.02116511
		Will ride share and autonomous jitneys replace the need for private vehicles?	113	0.268293	0.135622	0.069196	0.99849787	0.00150213
		Can you foresee replacing your need for a private vehicle with ride share and public trar	114	0.365854	0.147436	0.075224	0.95709361	0.04290639
		Can you foresee reducing your auto dependency to a single vehicle or less?	115	0.45	0.154172	0.078661	0.73645537	0.26354463
		Economics of parking						
		Accept a 100% increase in cost to build garage vs free standing deck ?	601	0.55	0.154172	0.078661	0.26354463	0.73645537
		Accept a 50% ncrease in cost to build mech. garage vs self access garage ?	602	0.195122	0.121304	0.061891	0.99995276	0.00004724
		Accept a 20% increase in cost to include a recreation deck above?	603	0.878049	0.100163	0.051105	6.45E-07	0.99999936
		Accpet the cost for an increase in capacity to eliminate all if not most on street parkng?	604	0.45	0.154172	0.078661	0.73645537	0.26354463
		Accept the cost for a visual and phone app. based inventory systemm?	605	0.775	0.129408	0.066026	0.00025211	0.99974789

APPENDIX F

Binary questions – Future trends

F -3 Binary questions – Statistical analysis – individual panels

BINARY RESPONSES INDIVIDUAL PANEL RESULTS

Sizing and automoble and parking use	prp_agg_all[36,5]					mrgerr_agg_all[36,5]					stderr_agg_all[36,5]					tstt0_agg_all[36,5]					tsttno_agg_all[36,5]				
RQ 1 Current practice	c1	panel1	panel2	panel3	panel4	c1	panel1	panel2	panel3	panel4	c1	panel1	panel2	panel3	panel4	c1	panel1	panel2	panel3	panel4	c1	panel1	panel2	panel3	panel4
Favor public parking built to support existing private holdings	101	0.500	0.900	0.800	0.818	101	0.310	0.186	0.248	0.228	101	0.158	0.095	0.126	0.116	101	0.500	0.006	0.029	0.017	101	0.500	0.994	0.971	0.983
Favor public parking built to support new private development	102	0.556	0.800	0.400	0.273	102	0.325	0.248	0.304	0.263	102	0.166	0.126	0.155	0.134	102	0.369	0.029	0.736	0.934	102	0.631	0.971	0.264	0.066
Favor Investing in visual and phone app. based inventory system?	103	0.700	0.889	0.900	0.636	103	0.284	0.205	0.186	0.284	103	0.145	0.105	0.095	0.145	103	0.103	0.010	0.006	0.183	103	0.897	0.990	0.994	0.817
Favor increase capacity to eliminate all if not most on street parkng?	104	0.100	0.333	0.500	0.818	104	0.186	0.308	0.310	0.228	104	0.095	0.157	0.158	0.116	104	0.994	0.841	0.500	0.017	104	0.006	0.159	0.500	0.983
Favor mix of tandem spaces in private mixed use ?	105	0.300	0.600	0.900	0.727	105	0.284	0.304	0.186	0.263	105	0.145	0.155	0.095	0.134	105	0.897	0.264	0.006	0.066	105	0.103	0.736	0.994	0.934
Favor mix tandem spaces in public structures ?	106	0.300	0.200	0.200	0.000	106	0.284	0.248	0.248	-999.000	106	0.145	0.126	0.126	-999.000	106	0.897	0.971	0.971	.	106	0.103	0.029	0.029	.
RQ2 Future trends																									
1 Parkign ratios depicted																									
Parking ratios. (0.8/ 1 bedroom, 1.2 / 2 bedroom) ?	107	0.700	0.800	0.600	0.455	107	0.284	0.248	0.304	0.294	107	0.145	0.126	0.155	0.150	107	0.103	0.029	0.264	0.618	107	0.897	0.971	0.736	0.382
Parking ratios support your family's needs ?	108	0.600	0.400	0.500	0.364	108	0.304	0.304	0.310	0.284	108	0.155	0.155	0.158	0.145	108	0.264	0.736	0.500	0.817	108	0.736	0.264	0.500	0.183
2 Current and future ownership expectations																									
Will your need for parking decrease with age?	110	0.444	0.800	0.700	0.727	110	0.325	0.248	0.284	0.263	110	0.166	0.126	0.145	0.134	110	0.631	0.029	0.103	0.066	110	0.369	0.971	0.897	0.934
Will overall demand for private vehicles reduce along with parking demand?	111	0.700	0.556	0.400	0.455	111	0.284	0.325	0.304	0.294	111	0.145	0.166	0.155	0.150	111	0.103	0.369	0.736	0.618	111	0.897	0.631	0.264	0.382
Does presense of public transportation change your responses to 1F & 1G ?	112	0.700	1.000	0.800	0.182	112	0.284	-999.000	0.248	0.228	112	0.145	-999.000	0.126	0.116	112	0.103	.	0.029	0.983	112	0.897	.	0.971	0.017
Will ride share and autonomous jitneys replace the need for private vehicles?	113	0.400	0.200	0.200	0.273	113	0.304	0.248	0.248	0.263	113	0.155	0.126	0.126	0.134	113	0.736	0.971	0.971	0.934	113	0.264	0.029	0.029	0.066
Can you foresee replacing your need for a private vehicle with ride share and public trans.?	114	0.200	0.500	0.300	0.455	114	0.248	0.310	0.284	0.294	114	0.126	0.158	0.145	0.150	114	0.971	0.500	0.897	0.618	114	0.029	0.500	0.103	0.382
Can you foresee reducing your auto dependency to a single vehicle or less?	115	0.500	0.444	0.300	0.545	115	0.310	0.325	0.284	0.294	115	0.158	0.166	0.145	0.150	115	0.500	0.631	0.897	0.382	115	0.500	0.369	0.103	0.618
3 Housing and living patterns																									
Can you foresee relocating to an urbanized setting depicted in these studies?	116	0.200	0.333	0.500	0.545	116	0.248	0.308	0.310	0.294	116	0.126	0.157	0.158	0.150	116	0.971	0.841	0.500	0.382	116	0.029	0.159	0.500	0.618
4 Commuting and work from home																									
Will work from home and co work settings replace the need to commute to work?	119	0.800	0.750	0.800	0.455	119	0.248	0.300	0.248	0.294	119	0.126	0.153	0.126	0.150	119	0.029	0.079	0.029	0.618	119	0.971	0.921	0.971	0.382
Commute to work at last three days a week?	120	0.900	0.889	1.000	1.000	120	0.186	0.205	-999.000	-999.000	120	0.095	0.105	-999.000	-999.000	120	0.006	0.010	.	.	120	0.994	0.990	.	.
Currently work from home at least part of the week?	121	0.100	0.667	0.100	0.200	121	0.186	0.308	0.186	0.248	121	0.095	0.157	0.095	0.126	121	0.994	0.159	0.994	0.971	121	0.006	0.841	0.006	0.029
Scale and Massing																									
RQ 1 Current practice																									
1 Proptypes - Street and open space issues																									
Low rise active frontage up is an important feature?	201	1.000	1.000	0.900	1.000	201	-999.000	-999.000	0.186	-999.000	201	-999.000	-999.000	0.095	-999.000	201	.	.	0.006	.	201	.	.	0.994	.
High rise active frontage is an important feature?	202	0.800	1.000	1.000	0.900	202	0.248	-999.000	-999.000	0.186	202	0.126	-999.000	-999.000	0.095	202	0.029	.	.	0.006	202	0.971	.	.	0.994
Mixed use models incorporate private open space, is this a problem?	203	0.100	0.400	0.400	0.100	203	0.186	0.304	0.304	0.186	203	0.095	0.155	0.155	0.095	203	0.994	0.736	0.736	0.994	203	0.006	0.264	0.264	0.006
2 Prototype and attributes																									
All three models appropriately sited in zone?	204	0.900	0.700	0.400	0.700	204	0.186	0.284	0.304	0.284	204	0.095	0.145	0.155	0.145	204	0.006	0.103	0.736	0.103	204	0.994	0.897	0.264	0.897
Podium additional front setback is an important feature?	205	0.900	0.800	0.600	0.800	205	0.186	0.248	0.304	0.248	205	0.095	0.126	0.155	0.126	205	0.006	0.029	0.264	0.029	205	0.994	0.971	0.736	0.971
High rise provides articulated base height an important gesture?	206	0.700	0.778	0.600	0.800	206	0.284	0.272	0.304	0.248	206	0.145	0.139	0.155	0.126	206	0.103	0.048	0.264	0.029	206	0.897	0.952	0.736	0.971
3 Height limits																									
Can height of structures exceed envelope limits?	207	0.600	0.700	0.600	0.727	207	0.304	0.284	0.304	0.263	207	0.155	0.145	0.155	0.134	207	0.264	0.103	0.264	0.066	207	0.736	0.897	0.736	0.934
High rise violates the sky plane, is this problematic?	208	0.600	0.400	0.600	0.700	208	0.304	0.304	0.304	0.284	208	0.155	0.155	0.155	0.145	208	0.264	0.736	0.264	0.103	208	0.736	0.264	0.736	0.897
Placement																									
RQ 1 Current practuce																									
Access restricted to minor streets and alleys?	401	0.700	0.900	0.900	0.909	401	0.284	0.186	0.186	0.170	401	0.145	0.095	0.095	0.087	401	0.103	0.006	0.006	0.003	401	0.897	0.994	0.994	0.997
Increase capacity to eliminate all if not most on street parkng?	402	0.100	0.333	0.500	0.818	402	0.186	0.308	0.310	0.228	402	0.095	0.157	0.158	0.116	402	0.994	0.841	0.500	0.017	402	0.006	0.159	0.500	0.983
All																									
RQ2 Future trends																									
Based on the above will parking lots and structures be significantly eliminated?	501	0.100	0.400	0.600	0.273	501	0.186	0.304	0.304	0.263	501	0.095	0.155	0.155	0.134	501	0.994	0.736	0.264	0.934	501	0.006	0.264	0.736	0.066
Will ride share and autonomous jitneys replace the need for private vehicles?	113	0.400	0.200	0.200	0.273	113	0.304	0.248	0.248	0.263	113	0.155	0.126	0.126	0.134	113	0.736	0.971	0.971	0.934	113	0.264	0.029	0.029	0.066
Can you foresee replacing your need for a private vehicle with ride share and public trans.?	114	0.200	0.500	0.300	0.455	114	0.248	0.310	0.284	0.294	114	0.126	0.158	0.145	0.150	114	0.971	0.500	0.897	0.618	114	0.029	0.500	0.103	0.382
Can you foresee reducing your auto dependency to a single vehicle or less?	115	0.500	0.444	0.300	0.545	115	0.310	0.325	0.284	0.294	115	0.158	0.166	0.145	0.150	115	0.500	0.631	0.897	0.382	115	0.500	0.369	0.103	0.618
Economics of parking																									
Accept a 100% increase in cost to build garage vs free standing deck ?	601	0.200	0.778	0.600	0.636	601	0.248	0.272	0.304	0.284	601	0.126	0.139	0.155	0.145	601	0.971	0.048	0.264	0.183	601	0.029	0.952	0.736	0.817
Accept a 50% ncrease in cost to build mech. garage vs self access garage ?	602	0.200	0.100	0.500	0.000	602	0.248	0.186	0.310	-999.000	602	0.126	0.095	0.158	-999.000	602	0.971	0.994	0.500	.	602	0.029	0.006	0.500	.
Accept a 20% increase in cost to include a recreation deck above?	603	0.800	0.800	1.000	0.909	603	0.248	0.248	-999.000	0.170	603	0.126	0.126	-999.000	0.087	603	0.029	0.029	.	0.003	603	0.971	0.971	.	0.997
Accpet the cost for an increase in capacity to eliminate all if not most on street parkng?	604	0.100	0.333	0.500	0.818	604	0.186	0.308	0.310	0.228	604	0.095	0.157	0.158	0.116	604	0.994	0.841	0.500	0.017	604	0.006	0.159	0.500	0.983
Accept the cost for a visual and phone app. based inventory systemm?	605	0.700	0.889	0.900	0.636	605	0.284	0.205	0.186	0.284	605	0.145	0.105	0.095	0.145	605	0.103	0.010	0.006	0.183	605	0.897	0.990	0.994	0.817

APPENDIX G

Sizing surveys

G – 1 Overview narrative and analysis – All surveys

Narrative – Sizing criteria and exploring of parking ratios as basis for determination of Size

While parking ratios were not the direct subject of this dissertation effort, the first criteria used in the analysis of models and prototypes - Sizing, did require that a basis to arrive at an appropriate parking ratio be derived.

The purpose of developing an appropriate method to derive these ratios was: 1) for use in the development of iterative design prototypes for mixed-use residential buildings of the following typologies: Low, Moderate and High density, and 2) for exploring the economic impacts of these ratios on these prototypes.

The sizing of parking amenities in the mixed-use residential building prototypes was based on the results of these comparative surveys.

A Five related analysis were conducted.

1). Survey of per household vehicle ownership rates in two Metropolitan statistical areas (NYC, Philadelphia and surrounding counties) using US Census 2010 Community survey data.

2). Review of NJ Residential Site Improvement Standards. Utilizing a determined unit mix, the comparative parking ratios for urban and suburban sites were derived from these state standards, Alternate options are also projected from these ratios.

3). Random survey of approved mixed-use developments in three northern NJ counties. Recording distance to transit, approved parking ratios on a per unit basis and applicable county density and household vehicle ownership rates.

4). Conducting and an on-line residents survey of parking use for an established transit located building in Hoboken, NJ – Metro Stop at 800 Jackson Avenue, Hoboken, NJ located directly at a transit stop on the Hudson-Bergen Light Rail line.

5). Review of responses by focus group members to the subject of parking ratios, vehicle ownership and other related issues directed at the issue of Sizing. Survey was conducted with four groups of ten members of various cross sections from lay, to professional to public officials

B These surveys were then compared to four sources in the literature.

1). Manhattan Core Parking Analysis – Dept of City Planning, 2011
2) Results of the recent Mortgage Bankers Association parking study dated 2018 for five cities.
3) Dissertation level parking ratio methodology conducted by Matt Cuddy at the Bloustein School in 2007.
4) Parking ratios as portrayed in Infill Development Standards and Policy Guide by (Listokin et al 2007 (which adopts Cuddy's methodology and approach).

The targeted ratios derived for this comparison are as follows.

Low-rise residential in suburban or ex urban places.	1.65 spaces/ unit average
Mid-rise residential in suburban area with transit access.	1.20 spaces / unit average.
High-rise residential in urban location with transit access.	1.00 spaces / unit average.

A Survey results

The results of the surveys outlined above are as follows.

1). Census based survey. Car ownership by household
(source US Census 2017 City and County census)

Vehicles per household		**County density**	
	Urban densities (3000 + /sq. mile)	**Suburban** (500-3000 / sq. mile)	**Rural** (0-500 / sq. mile)
NY MSA.	0.90	1.80	1.90
		(range - 0.26 NYC to 2.04 Putnam Cty)	
All NJ counties .	1.50	1.80	1.90
		(range - .97 Hudson to 2.03 Sussex Cty)	
Philadelphia MSA.	1.30	1.90	1.80
		(range - 1.01 Philadelphia to 1.95 Chester Cty)	
CT all. counties.	NA.	1.70	1.90
		(range - 1.57 Hartford to 1.97 Toland Cty)	
Mean by density	**1.23**	**1.80**	**1.88**
		(range – 0.26 NYC to 2.03 Sussex County)	

2). NJ RSIS review. Projections utilizing the following unit mix. (an average of 50% studio/1 bedrooms, 40% 2 bedrooms and 10% bedrooms)

RSIS.	High-rise/ Urban ratios	1.33 spaces / unit
	Mid-rise / Suburban ratios	1.97 spaces / unit
	Average	1.65 spaces /unit

Alternates to RSIS based on surveys above:

Option A*	Urban	50% Studio/1 bedrooms at 0.80/unit
		50% 2 and 3 bedrooms at 1.20/unit
	Average	**1.00 spaces/unit**

Option B*	Suburban	50% Studio/1 bedrooms at 0.80/unit
	downtown	50% 2 and 3 bedrooms at 1.60/unit
	Average	**1.20 spaces/unit**
Option C.	Suburban	50% Studio/1 bedrooms at 1.40/unit
		50% 2 and 3 bedrooms at 1.88/unit
	Average	**1.64 spaces/unit**

*with walkable transit access.

2) **Survey of twelve randomly selected area mixed-use approvals in Northern NJ**
(located in Essex, Morris, and Somerset counties)

Average distance to transit site	0.86 miles	(range 0.10 to 2.50 miles
Average approved parking ratio	**1.81 per unit**	(range 1.32 to 2.58 per unit)

(point of convergence - 1.50 miles and 1.50 spaces per unit)

County density ranged from 1,100 to 6,500 people per sq. mile for all surveyed sites and county.

County per family vehicle rates: **1.30 to 1.90** **(a mean of 1.80)**

4). Hoboken building survey **Metro stop - 800 Jackson Avenue, Hoboken, NJ**
(for 25 respondents, 113 units an approx. 22.1% response rate)

Number of parking spaces owned or rented: 14 -1 car (56%) 4 - 2 cars (16%) 7 - car less (28%)

Derived ratio: 14 + 8 = 22 for spaces for 22% of residents = 1.00/resident

Parking at Metro stop or elsewhere 88% rent at Metro stop. 12% park on street

Of the 88% who rent number of spaces and by types:
60% rent 1 self-access space
33% rent 1 self-access of tandem space
7% lease both self-access and tandem

Derived ratio: 11.6 + + 6.4 + 2.8 = 19.8 spaces for 19.4 residents = 1.02 ratio
(13/19.8 = 66% self-access, 6.4/19.4 = 34% tandem)

Commuting patterns - 65% used public transportation, of that 65%:
90% use light rail system located at the building
18% commute by car or motorcycle
13% walk or bike to work
4% do not work.

Of 15 who responded to questions about their extended commute:

67% use light rail system located at the building
47% use the PATH system
47% use at NJ Transit bus in their commute
20% use a NY Transit subway

Patterns of use for car owners: 50% use car their Mon., Tues., Wed., and Thur.
100% use their car Fri., Sat. and Sun.

Age of respondents	18-30	21%.
	32-40	71%
	Over 40	8%
Status of residents	Owners	92%
	Renters	8%
Years of residency on site	2 years or less	23%
	3-5 years	46%
	5 or more years	21%

5). Focus group review

(Proposed 0.80 1 bedroom and 1.20 2-bedroom ratios in transit located zones / versus preferences for personal use)

Percentage that agreed to 0.80 1-bedroom and 1.20 2-bedroom ratios for:

	Transit zones	Personal use
Lay persons	70.0%	60.0%
Professional senior	80.0%	40.0%
Professional millennial	60.0%	50.0%
Public officials	45.0%	36.4%
Average groups.	63.5% - YES	46.3% - NO

Percentage in agreement

	Transit access impacts opinion?	Vehicles in family	Need will decrease with age?	Vehicles reduce with ride share/ transit?	Reduce to 1 car?
Lay persons	70%	2.10	44%	20%	50%
Professional senior	100%	1.89	80%	50%	44%
Professional Mill.	80%	2.60	70%	30%	30%
Public officials	18%	3.10	73%	46%	55%
Average all groups	66% - YES	2.43 – vehicles	68% - YES	37% - NO	45% -NO

B Literature comparative sources

Review of related literature sources directed at parking ratios for residential uses

1 NYC Dept of City Planning – 2011 Manhattan Core Parking Study (NYDCP 2011)

a. Average vehicle ownership per household:

1980	22%.
1990	26%.
2000	27%.
2009	26%.

b. Study also revealed average monthly rental rates per space by location:

City/location	**Monthly rental per space**
Manhattan mid-town	$ 538
Manhattan downtown	$ 529
Philadelphia	$ 300
Seattle	$ 285
Phoenix	$ 40

Note: MBA cities Des Moines and Jackson Hole were excluded from the list (reference below).

2 Mortgage Bankers Association's Parking Study - 2018 (MBA 2018)

	Households /acre	Spaces /acre	Ratio/ household	Parking On street.	Surface.	Garaged /Decks
NYC	16.2	10.1	**0.62**	65.3%	16.6%	18.1%
Philadelphia	6.8	25.3	**2.72**	20.4%	68.4%	11.2%
Seattle	5.7	29.5	**5.18**	32.2%	35.1%	32.7%
Omaha.	1.5	28.4	**28.42**	10.3%	82.8%	6.9%
Jackson hole	2.0	53.8	**26.90**	13.0%	84.5%	2.4%

3 Cuddy dissertation study (Cuddy, 2007)

VULO method (Vehicles from Unit choice with a Location-based Offset) is the basis of analysis

Factors include: 1)Location, 2) Availability, 3) Use, 4) Density, and 5) Unit and building type

Dissertation advances no particular ratios but prel. analysis was adopted in the following study with the projections as noted

4 **Listokin study –** *Smart Growth and Infill: Challenge, Opportunity and Best Practices* (Listokin et all, 2007)

Later adopts Cuddy's methods and utilizes - Public Use Microdata Areas (PUMAs) as the basis for factors contributing to locational standards (Cuddy, 2007)

Example 1 **South Orange NJ – Essex County Gas Light project – 200 units at transit station**

Town density – 5,673 people / sq. mile – Urban

One-bedroom calc.

.32 + .12 loc adjust = .51 + visitor adjust . 27 = 1.00

Two-bedroom calc.

.73 + .12 loc adjust = .85 + visitor adjust . 27 = 1.13

For an average for 50/50 mix of S/1 and 2/3 bedrooms = 1.065

Example 2 **Boonton, NJ – Morris County – Fictious project 60-unit multi-family**

Town density - 3576 people / sq. mile – Suburban

One-bedroom calc.

1.09 + .02 loc adjust = 1.11 + visitor adjust . 27 = 1.38

Two-bedroom calc.

1.63 + .02 loc adjust = 1.65 + visitor adjust . 27 = 1.92

For an average for 50/50 mix of S/1 and 2/3 bedrooms = 1.65

Note: **Averages used in the prototype studies range as follows and are therefore consistent with Listokin's and Cuddy's projections:**

Description	For this dissertation	L/C projection
Low-rise residential in suburban or ex urban places.	1.65 spaces/ unit average	1.65 spaces aver.
Mid-rise residential / suburban *	1.20 spaces / unit average.	1.10 spaces aver.
High-rise residential / urban *	1.00 spaces / unit average.	NA

*an adjusted for walkable transit access

APPENDIX G

Sizing surveys

G - 2 Demographic survey – County density and automobile ownership

KIMMERLE SURVEY COUNTY POPULATION AN DENSITY VS FAMILY VEHICLE OWNERSHIP - 2017 CITY AND COUNTY CENSUS JUNE 22, 2019

Vehicles per family survey — Cenuus 2017 — American Community Survey — 21-Jun-19

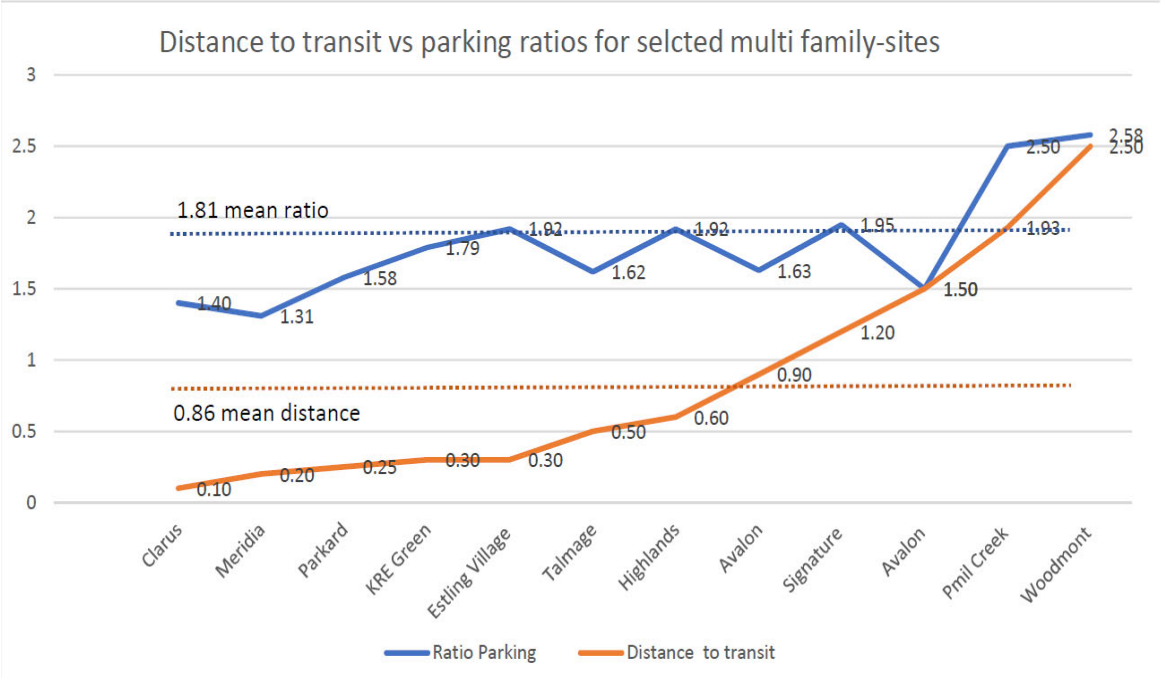
State	County	Urban		(3000 /SM and higher)					Suburban		(3000-500/SM)					Rural		(500/SM and below)				
		Pop (1000)	Area (SM)	Density Pop/SM)	Total Families	Fam size	Total Vehicles	Ratio/ fam		Pop (1000)	Area (SM)	Density Pop/SM)	Total Families	Fam size	Total Vehicles	Ratio/f am		Pop (1000)	Area (SM)	Density Pop/SM)	Total Families	Fam size	Total Vehicles	Ratio/ fam
NY	New York	1673.90	22.83	73320.19	758.30	2.21	200.53	0.26	Westchester	975.30	430.50	2265.51	345.70	2.82	541.69	1.57	Orange	378.20	811.70	465.94	126.50	2.99	226.04	1.79
	Bronx	1455.80	42.10	34579.57	485.40	2.94	277.48	0.56	Rockland	325.10	173.60	1872.70	100.00	3.25	176.94	1.77	Putnam	99.50	230.30	432.05	34.30	2.90	70.08	2.04
	Kings	2635.10	70.82	37208.42	944.70	2.79	542.07	0.57	Suffolk	1497.60	912.00	1642.11	489.30	3.06	982.68	2.01	Dutchess	295.70	795.60	371.67	107.40	2.75	193.34	1.80
	Queens	2399.30	108.53	22107.25	777.90	3.08	716.55	0.92																
	Richmond	476.00	58.37	8154.87	166.20	2.86	245.04	1.47																
	Nassau	1363.10	284.70	4787.85	444.10	3.07	832.76	1.88																
NJ	Hudson	679.80	47.00	14463.83	252.40	2.69	244.31	0.97	Passaic	510.60	185.00	2760.00	162.40	3.14	248.01	1.53	Hunderton	125.70	430.00	292.33	46.80	2.69	99.17	2.12
	Essex	800.40	126.00	6352.38	280.30	2.86	365.75	1.30	Middlesex	804.30	311.00	2586.17	286.80	2.80	496.91	1.73	Sussex	149.60	521.00	287.14	53.60	2.79	108.80	2.03
	Union	532.40	103.00	5168.93	188.00	2.83	306.91	1.63	Morris	498.80	469.00	1063.54	180.10	2.77	350.12	1.94	Warren	108.80	358.00	303.91	41.40	2.63	77.94	1.88
	Bergen	937.90	234.00	4008.12	337.80	2.78	584.53	1.73	Somerset	333.30	305.00	1092.79	116.00	2.87	222.58	1.92								
	Camden	511.00	222.00	2301.80	187.00	2.73	306.76	1.64	Burlington	448.20	805.00	558.01	164.40	2.73	313.60	1.91	Atlantic	272.90	561.00	486.45	106.90	2.55	161.30	1.51
									Gloucester	291.40	325.00	896.62	104.80	2.78	199.44	1.90	Salem	63.80	338.00	188.76	24.00	2.66	44.16	1.84
									Ocean	589.70	636.00	927.20	223.00	2.64	392.30	1.76								
CT									Hartford	897.40	736.00	1219.29	348.90	2.57	583.17	1.67	New London	270.80	666.00	406.61	107.20	2.53	197.18	1.84
									Fairfield	947.30	626.00	1513.26	337.70	2.81	618.96	1.83	Middlesex	164.10	369.00	444.72	66.60	2.46	127.62	1.92
									New Haven	862.10	606.00	1422.61	327.40	2.63	543.08	1.66	Toland	151.60	410.00	369.76	54.90	2.76	108.03	1.97
																	Litchfield	184.50	920.00	0.20	74.60	2.47	144.78	1.94
																	Windham	116.70	513.00	0.23	44.50	2.62	83.22	1.87
PA	Philadephia	1569.70	134.00	11714.18	591.30	2.65	599.90	1.01	Montgomery	818.70	483.00	1695.03	312.80	2.62	568.49	1.82	Berks	415.50	857.00	484.83	153.90	2.70	281.55	1.83
	Delaware	563.40	184.00	3061.96	204.90	2.75	335.83	1.64	Bucks	626.50	604.00	1037.25	235.90	2.66	455.29	1.93								
									Lehigh	360.80	346.00	1042.77	137.20	2.63	239.25	1.74								
									Northampton	301.00	370.00	813.51	113.80	2.64	212.80	1.87								
									Chester	514.70	750.00	686.27	188.60	2.73	366.96	1.95								

APPENDIX G

Sizing surveys

G - 3 Survey parking approvals/entitlements – Ratios to distance to transit

Site No	Description	Location	Ratio Parking	Distance to transit	Cty	Cty Density	Cars Family
1	Clarus	Maplewood	1.40	0.10	Essex	6.50	1.30
2	Meridia	Bound Brook	1.31	0.20	Somerset	1.10	1.90
3	Parkard	Boonton	1.58	0.25	Morris	1.10	1.90
4	KRE Green	Madison	1.79	0.30	Morris	1.10	1.90
5	Estling Village	Denville	1.92	0.30	Morris	1.10	1.90
6	Talmage	Bound Brook	1.62	0.50	Somerset	1.10	1.90
7	Highlands	Morris Plains	1.92	0.60	Morris	1.10	1.90
8	Avalon	Boonton	1.63	0.90	Morris	1.10	1.90
9	Signature	Morris Plains	1.95	1.20	Morris	1.10	1.90
10	Avalon	Maplewood	1.50	1.50	Essex	6.50	1.30
11	Pmil Creek	Parsippany	2.50	1.93	Morris	1.10	1.90
12	Woodmont	Cedar Knolls	2.58	2.50	Morris	1.10	1.90
			1.81	0.86		2.00	1.80



APPENDIX G

Sizing surveys

G - 4 Residential Site Improvement standards survey and analysis

Urban Hi rise per RSIS	Units	Ratio	Mix	Total
	Stud/1 bed rms	0.80	50.0%	40.0
	2 bed rms	1.30	40.0%	52.0
	3 bedrms	1.90	10.0%	19.0
	Average	1.33	100.0%	92.0

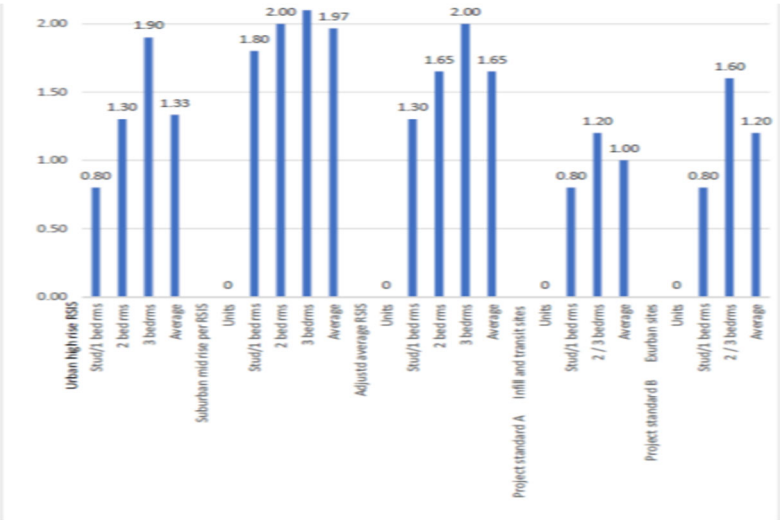
Average		
0.00	1.00/1.20	Proposed
0.00	1.65	Adjusted
0.00	1.65	Beyond suburban

Suburban Mid rise per RSIS	Units	Ratio	Mix	Total
	Stud/1 bed rms	1.80	50.0%	90.0
	2 bed rms	2.00	40.0%	80.0
	3 bedrms	2.10	10.0%	21.0
	Average	1.97	100.0%	170.0

Adjusted average	Units	Ratio	Mix	Total
	Stud/1 bed rms	1.30	50.0%	65.0
	2 bed rms	1.65	40.0%	66.0
	3 bedrms	2.00	10.0%	20.0
	Average	1.65	100.0%	131.0

Prop A Infill Transit Exurban	Units	Ratio	Mix	Total
	Stud/1 bed rms	0.80	50.0%	40.0
	2 / 3 bedrms	1.20	50.0%	60.0
	Average	1.00		100.0

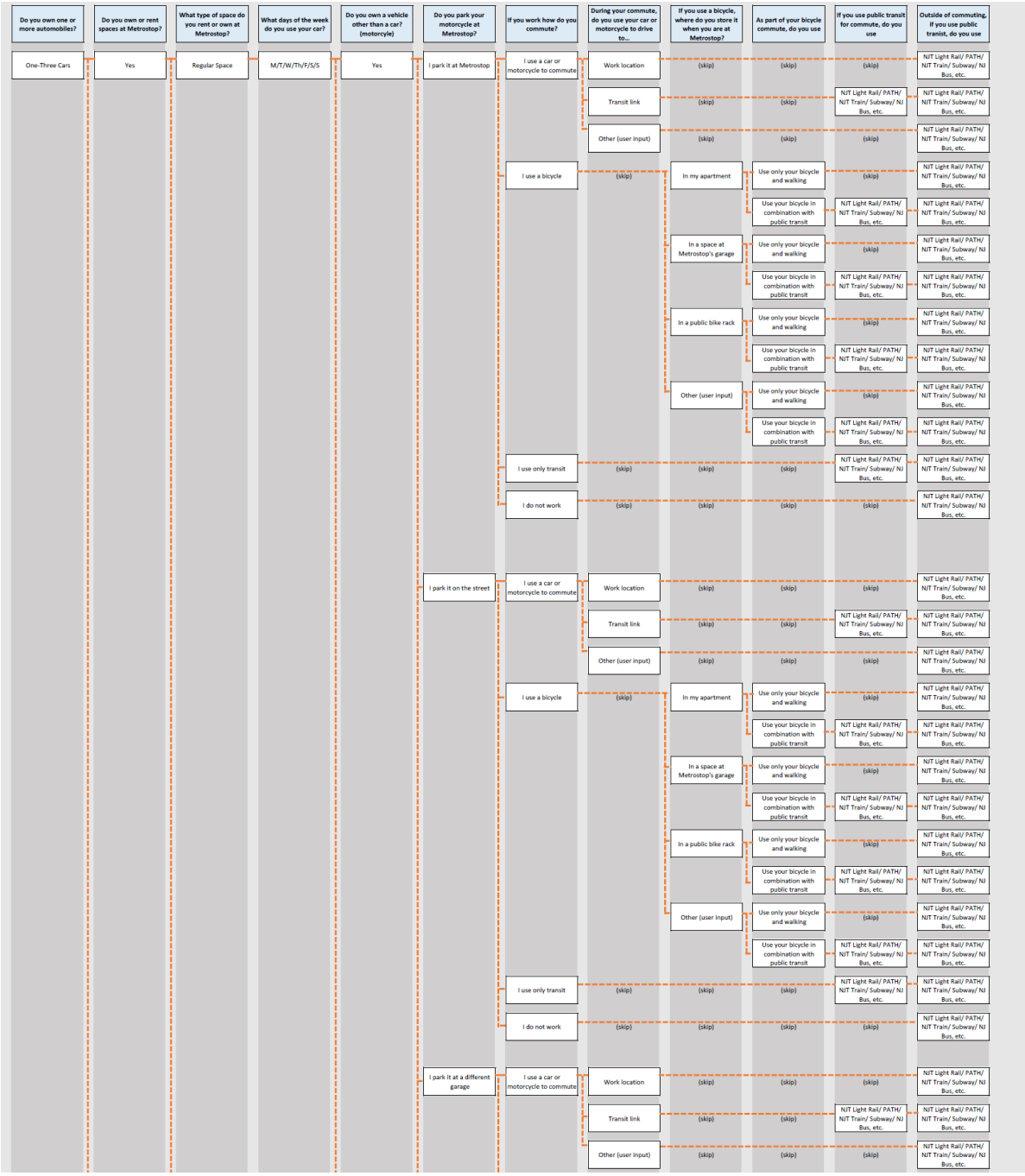
Prop B Infill Transit Exurban	Units	Ratio	Mix	Total
	Units	0.80	50.0%	40.0
	2 / 3 bedrms	1.60	50.0%	80.0
	Average	1.20		120.0



APPENDIX G

Sizing surveys

G - 5 Hoboken transit located building online survey



APPENDIX H

Economics of Parking

H - 1 Economics of parking – Pie charts costs / Parking structures

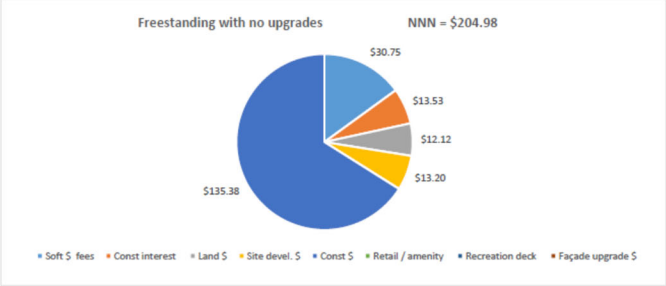
Parking garages / parking structures	Kimmerle	1-Jul-19

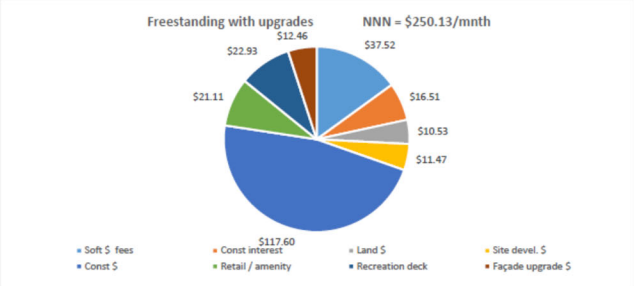
Freestanding with no upgrades							Cost ($mil)	NNN Monthly ($)
							$11.16	$204.98
Soft $ fees	Const interest	Land $	Site devel. $	Const $	Retail / amenity	Recreation deck	Façade upgrade $	Automation $
$30.75	$13.53	$12.12	$13.20	$135.38				

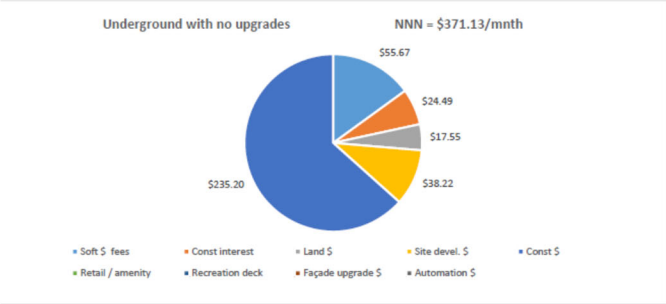
Freestanding with all upgrades except automation								Cost ($mil)	NNN Monthly ($)
								$15.67	$250.13
Soft $ fees	Const interest	Land $	Site devel. $	Const $	Retail / amenity	Recreation deck	Façade upgrade $	Automation $	
$37.52	$16.51	$10.53	$11.47	$117.60	$21.11	$22.93	$12.46		

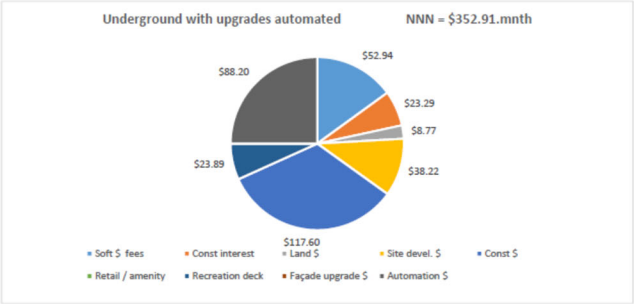
Underground garage with standard access, no upgrades							Cost ($mil)	NNN Monthly ($)
							$13.95	$371.13
Soft $ fees	Const interest	Land $	Site devel. $	Const $	Retail / amenity	Recreation deck	Façade upgrade $	Automation $
$55.67	$24.49	$17.55	$38.22	$235.20				

Under ground garage with automated robotic system and recreation deck								Cost ($mil)	NNN Monthly ($)
								$26.54	$352.91
Soft $ fees	Const interest	Land $	Site devel. $	Const $	Retail / amenity	Recreation deck	Façade upgrade $	Automation $	
$52.94	$23.29	$8.77	$38.22	$117.60		$23.89			$88.20





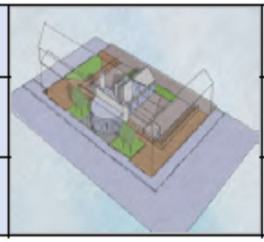
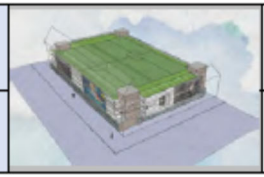




APPENDIX H

Economics of Parking

H - 2 Economics of parking – Rents / Parking structures

A	Economics of parking decks				Jun-19
Alternate	Illustration	Prototype model	Land cost/space ($mil)	Number of total spaces	Monthly cost of parking per space
1A		Freestanding no upgrades	$1,790.63	470.00	$286.4
1B		Freestanding with retail** upgrade	$1,790.63	470.00	$313.3
2A		Underground garage	$3,546.10	282.00	$533.6
2B		Underground garage with recreation	$3,546.10	282.00	$594.8
2C		Underground garage with recreation and automation *	$1,492.19	564.00	$515.4
3A		Freestanding with retail** and recreation upgrade	$1,790.63	470.00	$342.57
3B		Freestanding with retail**, recreation and façade upgrade	$1,790.63	470.00	$358.46

* Assumes mechanical / automated systems will double capacity for same base costs of shell required.

** Value of retail rent has been excluded and is considered a wash for purposes of analysis

APPENDIX H

Economics of Parking

H - 3 Economics of parking – Pie charts costs / Mixed use structured parking

Mixed use with structured parking	Kimmerle	1-Jul-19

Low rise wrap around - no upgrades								Cost ($mil)	NNN Monthly ($)
								$32.00	$2,552.79
Soft $ fees	Const interest	Land $	Site devel. $	Unit Const $	Parking Const $	Retail / amenity	Recreation deck	Façade upgrade $	
$382.92	$168.48	$485.10	$97.74	$1,176.00	$242.55				

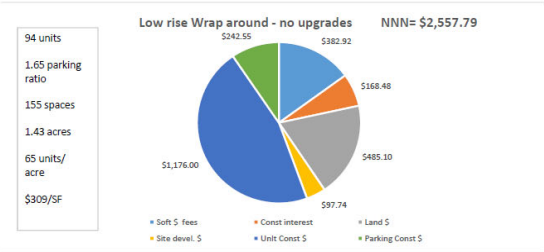
Low rise wrap around - with upgrades								Cost ($mil)	NNN Monthly ($)
								$37.13	$2,962.66
Soft $ fees	Const interest	Land $	Site devel. $	Unit Const $	Parking Const $	Retail / amenity	Recreation deck	Façade upgrade $	
$444.40	$195.54	$485.10	$97.74	$1,176.00	$242.55	$98.52	$150.13	$72.69	

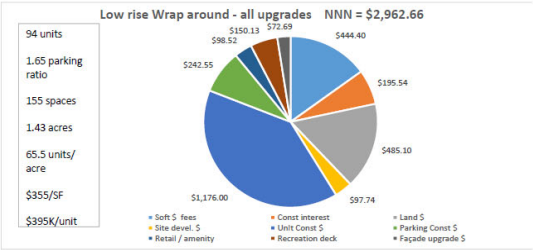
Mid rise Podium - no upgrades								Cost ($mil)	NNN Monthly ($)
								$43.73	$2,733.09
Soft $ fees	Const interest	Land $	Site devel. $	Unit Const $	Parking Const $	Retail / amenity	Recreation deck	Façade upgrade $	
$409.96	$180.38	$646.80	$45.94	$1,323.00	$127.01				

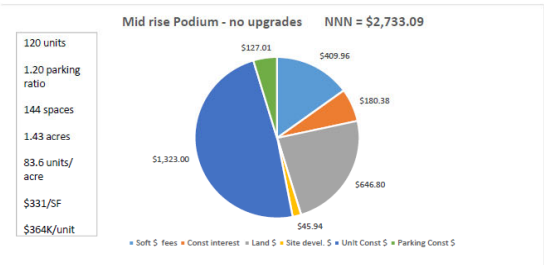
Mid rise Podium - with upgrades								Cost ($mil)	NNN Monthly ($)
								$46.46	$2,903.77
Soft $ fees	Const interest	Land $	Site devel. $	Unit Const $	Parking Const $	Retail / amenity	Recreation deck	Façade upgrade $	
$435.56	$191.65	$646.80	$45.94	$1,323.00	$127.01	$51.45	$0.00	$82.36	

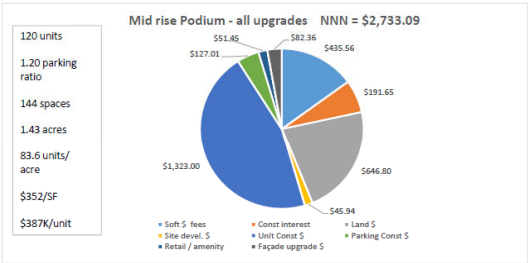
High rise mid stack - no upgrades								Cost ($mil)	NNN Monthly ($)
								$84.78	$3,382.34
Soft $ fees	Const interest	Land $	Site devel. $	Unit Const $	Parking Const $	Retail / amenity	Recreation deck	Façade upgrade $	
$507.35	$223.23	$970.20	$46.91	$1,470.00	$164.64				

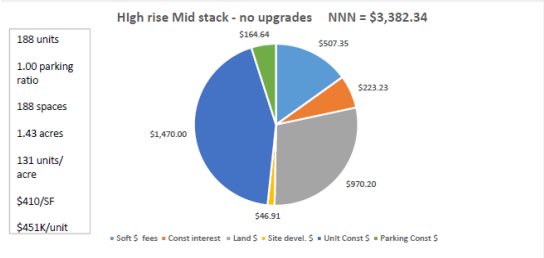
High rise mid stack - with upgrades								Cost ($mil)	NNN Monthly ($)
								$97.38	$3,884.86
Soft $ fees	Const interest	Land $	Site devel. $	Unit Const $	Parking Const $	Retail / amenity	Recreation deck	Façade upgrade $	
$582.73	$256.40	$970.20	$46.91	$1,470.00	$164.64	$105.56	$131.36	$157.06	

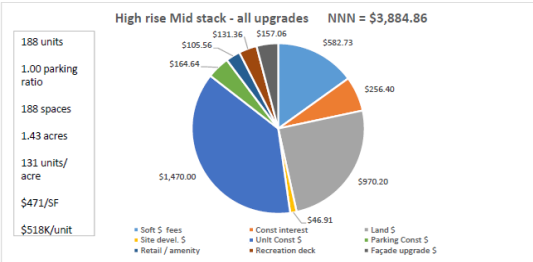












APPENDIX H

Economics of Parking

H - 4 Economics of parking – Rents / Mixed use structured parking

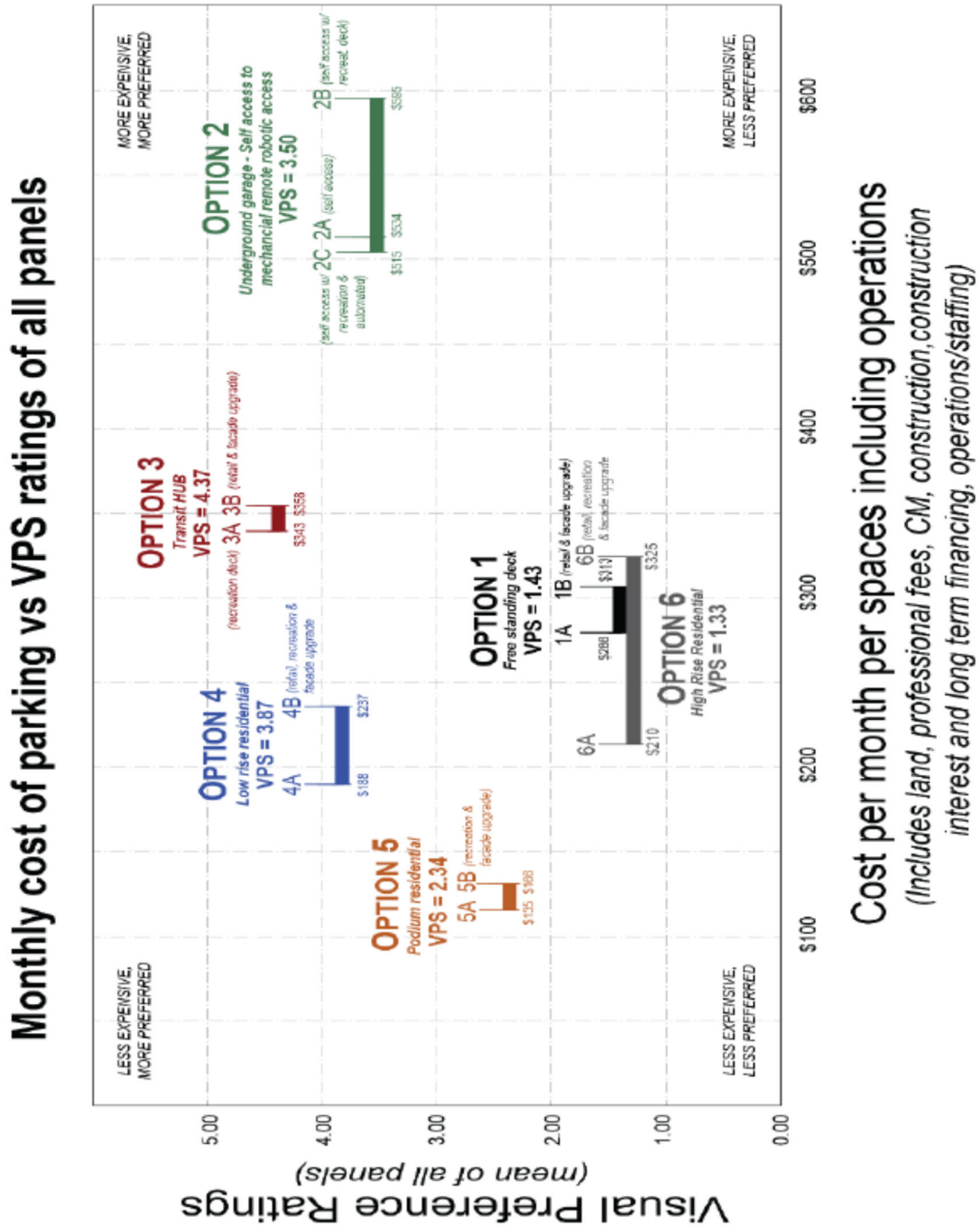
B	Economics of mixed use prototypes with structured parking					Jun-19		Upgrade cost per unit / month			Equalized costs	by ratio	Equalized costs	per space
Prototype	Illustration	Alternate	Description	Land cost	Unit rent	Parking ratio	Monthly cost parking per unit	Amenity / retail space	Recreation deck upgrade	Façade upgrade	Parking cost per unit based on ratios allocated	Cost as a percentage of unit rent	Parking cost per single space	Sgl. space cost as a perc. of unit rent
Low- rise Wrap-around Residenital use		1	Parking excluded from rent - No upgrades	$75.00	$3,343.42	1.65	$0.00	$0.0	$0.0	$0.0	$0.00	0%	$0.00	0%
		2	Parking in rent - No upgrades	$75.00	$3,652.79	1.65	$309.38	$0.0	$0.0	$0.0	$309.38	8.47%	$187.50	5.13%
		3	Parking in rent - All upgrades	$75.00	$4,062.66	1.65	$309.38	$125.7	$191.5	$92.7	$443.65	10.92%	$236.83	5.83%
Mid-rise Podium Residenial use		2	Parking excluded from rent - No upgrades	$100.00	$3,671.09	1.20	$0.00	$0.0	$0.0	$0.0	$0.00	0%	$0.00	0%
		1	Parking in rent - No upgrades	$100.00	$3,833.09	1.20	$162.00	$0.0	$0.0	$0.0	$162.00	4.23%	$135.00	3.52%
		3	Parking in rent - All upgrades	$100.00	$4,003.77	1.20	$162.00	$65.6	$0.0	$105.0	$206.66	5.16%	$166.02	4.15%
High - rise Mid-stack Mixed-use Residential		1	Parking excluded from rent - No upgrades	$150.00	$4,272.34	1.00	$0.00	$0.0	$0.0	$0.0	$0.00	0%	$0.00	0%
		2	Parking in rent - No upgrades	$150.00	$4,482.34	1.00	$210.00	$0.0	$0.0	$0.0	$210.00	4.69%	$210.00	4.69%
		3	Parking in rent - All upgrades	$150.00	$4,984.86	1.00	$210.00	$134.64	$167.55	$200.33	$324.62	6.51%	$324.62	6.51%

Note.	Allocation of upgrades		Low rise 1.65 ratio		Mid rise for 1.20 ratio		High rise for 1.0 ratio	Upgrade alloc.
	Based on applciable parking ratios		1100 +536 = 1,636	32.76%	1100 + 390 = 1,490	26.17%	1100 +325 = 1425.	22.81%
	Based on allocation for a single parking space			19.86%		21.81%		22.81%

APPENDIX H

Economics of Parking

H - 5 Scatter plot – All prototypes – Rents vs VPS rankings



APPENDIX I

Transcripts VPS sessions and Professional Interviews

I – 1 VPS sessions – Panel transcripts

GROUP 1 - Lay users panel **April 23, 2019 930 PM – 1200 AM**

Moderator

"You pull into an elevator, get out of your car, it's going to go down on its own. Essentially, a robotic system. You're going to retrieve with a little screen, then you punch in the number. It's going to give you your car back."

"And the car comes to you? You're not going looking for it?" "It's safer as well."

Guest

"Walk around when a hobo gets in there…"

"It might take a little more time. That and also, the parking garage where I've worked, the elevators, they're always out. What if something goes wrong and you can't get your car? That happened the other day and the arm was broken on our parking garage, so everybody was driving through Trenton trying to find parking. It's not a great place to…"

"No. Like you said, you drive and there's so many empty buildings vacant and they're like, what are you going to do with all these?"

Guest

"I think you hit the nail on the head when you said millennials because that's the way it's going. I know my nieces, both are millennials, and they don't care if they have a car. They Uber everywhere. Also, I have a couple of friends in Brooklyn. They, we don't have a car. They like this in more city areas."

"Can't afford housing right now, so you're going to own a car."

Guest

"But I take the train, and these are popping up all over the northeast corridor. I see it and I'm like, wow. They're building one Harrison right now that they're building a couple of them. Trenton is a horrible neighborhood, but they're trying to improve it and they built this loft with this parking and it's really cool. They're trying to get it out there, so I foresee this is as definitely the way they're…"

Guest

"Yeah, I was thinking of more you were going to ask about parking spaces, the ins and outs of parking garages. I was ready to bring my pains just because…"

“It’s a nightmare in this parking building. This location, in particular, is a very… It’s on an island. I call this an island.” “Yes, it’s so weird to get to.”

“We have had situations where the snowstorm where it was closed because a truck got stuck on that ramp. Nobody could get out. Nobody. It was 11:30…”
“Yeah. There was no other way out. Even that building behind us, the Monaco where it has that podium parking, the parking’s on that main level down, everything’s on top, they had to have a bus that comes there because there’s no other way. Again, there, you wouldn’t need a car. But where would you go?”

Guest

“There’s definitely parking garage fails and I see it in Trenton. But one of the major things is like the older people, when the elevator’s broken, they don’t know how to get to their car if it’s on the sixth or seventh floor. Somebody will usually go and drive them up to the thing, but then they can’t do the stairs, so they have to walk. Then there’s cars shooting around. That’s a dangerous…”

“It could be a dangerous environment too.”

GROUP 2 - Senior architects panel **April 23, 2019 130 PM - 400 PM**

Moderator

Question is wo all prototypes work in the Infill simulation and if not why not?

Guest

"You did have some decision though where you placed your prototypes. That one on the end, which is the flat one, which is submerged, if you had put that one in where the high-rise is it's a different context. It fits better, I think. I'm not trying to… I'm just trying to say that there is some biased of where you placed your prototypes and it does affect whether or not… That high-rise works in the middle more than it would work I think over anything."

"Well, there's a couple ways of looking at that. In some ways it doesn't work well in the center, but in another way of looking at it, the submerged would be, could be better in the center as well because it creates a wide-open plaza."

Guest

"I keep thinking about, I think you referenced earlier with respect to zoning standards and the role… The changing role of vehicles in urban play in terms of quantity of vehicles."

"Yeah, but where exactly? I understand we need this in Jersey City, Hoboken, which was basically urban as compared to being out in Moorestown. You can't survive out there without…"

"Yeah, but at which one? Are you going to use open space for development or open space for a field?"

"It's like military parking in Newark"

Re On street parking being eliminated

Guest

"So, the visitors have no place to park?"

Guest

"They're going to be in the garage."

"Could you imagine what it means for a person to go look for a parking deck and then have to go in and out of the store to do it?

Let's just suppose for the moment… I guess I get a no from you.

"I disagree, yeah, exactly."

Moderator

I'm going to take it one step further.

So, the point is, pick up the phone, I just drove down Fifth Street, oh, there are four spaces in the deck, a block up. I'm driving right there. I'm not circling. I'm not waiting for on-street space.

Like it's stated that 60% of downtown traffic is people just wandering looking for available spaces.

Guest

"People will do that for 40 minutes before they'll go into a parking garage."

"That's true."

"They'll avoid a parking garage at any cost."

Moderator

How about closed streets, whole pedestrian streets that have relevant success, especially on the retail side; sometimes it works, sometimes they don't.

This isn't proposing that they're closing the streets; it just says we're re-capturing the parking lane, we're going to use it differently, and we're doing that so we're taking a lot of traffic off the street.

Guest

"It serves different needs, to take the parking off the street, is ideal for walking shops; but if you're the merchant trying to stock that shop, you're screwed. You have nowhere to load…"

Guest

"I have an inner-city architectural problem. I can count on one hand in 30 years the number of clients who have driven to the city to visit me in my office. They won't come. They can't park. It becomes an issue. And do they want to pay to park? No."

Moderator

Placement in the infill model. Do they all work? Again, it's all relevant; everything here is a relevant answer.

Guest

"What's running through my mind, is looking, having seen your checkerboard, is the space in these garages and replacing them in the four corners on the outside? I can deal with a least

expensive but freestanding deck and decorate it later… As far as the take the cars out of the center of the city, as far as stocking the shelves, as far as storage… I don't know if anyone knows what happened at Garden State Plaza? They originally built an underground truck way to bring trucks into those subterranean to stock their stores, but there's no going up."

Moderator

We're going to talk about changes in attitude, and the idea that Millennials don't get cars and don't even get their licenses until they're in their mid-twenties.

Guest

"So, is that more change about that?"

"Another aspect of this is just management, so Hackensack where I live… Back in the late eighties or early nineties, they built a public garage downtown. It was supposed to jumpstart the new… Whatever What they found was that the homeless were sleeping there at night and they weren't generating enough car traffic at night to… So basically, what they did was to…

They did a couple of things. Which were wrong, not necessarily wrong but they closed it up with fencing, established a guard there, and just closed it at night, period, so not available. And then the second thing they did, which is a continuing thing, is any building that you wanted to design or construct downtown, those sites had any parking in the downtown, but you had to comply with the zoning ordinance to some extent.

So, the town would rent spaces. So they rent spaces in (inaudible) and most of it is a parking garage, and of course it's the land owners who rent spaces and so when you look at these parking slots, they're half empty because the parking requirement is so absurd that they are all rented by people who don't really need them."

Moderator

The point of this, right, is what is the appropriate standard.

Guest

"My town is very sensitive to parking and I think it's almost an emotional thing in some way an idealistic thing… In throwing an apartment, let's say, a garden apartment… Close to where I live there was a building in the 60's with 20/30 units, and at that time the parking was 1.1 cars, one car per dwelling unit plus 10%. And it was on a major thoroughfare with buses… And we were adding two basement units to justify the parking. Well, I counted up the spaces and they were 1.1 but they weren't all being used."

Guest

"You're missing the biggest point of it. You're missing the economic factor. And let me put it from this… 30 years ago I worked in Summit. Summit had built a public garage behind its downtown area."

Guest

The one by the train station?

"It's more in the heart of it. Its downtown. It would be behind I guess that's Springfield Avenue… It's behind all those retail shops. It costs 50 cents an hour to park; nobody looks for parking on the street at 50 cents an hour. Pull into the deck."

"So, they came up six months, nine months ago with a proposal. We want the town to subsidize our Uber rides to the train station. So, we want the town to take the same money they would have spent on the deck and distribute that to the users of parking and let's just Uber it and forget about building models and construction. I thought was pretty smart; huge battle".

Guest

"Well they should wait until Uber becomes popular and see if it survives."

They came to a consensus, but it's the right thought. Why go…

"Then you get people driving from out of something that use those decks because they need to get to a central train station."

"Mass transit should have gone the way of the dinosaurs centuries ago."

Moderator

But my point is all this is in place. People are saying why aren't we doing it the same way we've done it for the last 60 years? Everything is changing, so let's fast-forward. It's not necessary to do any of this; let's just say we want to rebuild it in another way.

"It doesn't work on a generic basis because Summit and Madison, Morristown, are completely different than Newark and Jersey City."

Guest

It could have been anywhere; it doesn't even have to be in the building because they go there once a week.

"Half of my staff doesn't have a car… 50%."

"You pick the other extreme. I used to spend $10.00 for that same hour for parking. Why run a business in the middle of downtown if anyone who is coming to see you is inconvenienced? So, does that help downtown? Not really."

Moderator

My question is not whether I do; the question is whether you do. Again, in whole, not just this generation sitting here, but your kids and your kids' kids… Do you believe that this whole move towards something else is in fact real?

Guest

"Yeah, when you go outside this area and you go out Midwest, it's (inaudible) and everybody's got a car out there."

Guest

"But some of us have four or five cars… Is that a trend that's going to continue or are we all going to end up with one and a half because we find a more convenient way to do it?"

"I'm hoping to go from three to six… That's just me.

Moderator

All kind of cultural stuff … The last piece here is more personal questions. And that kind of closes the formal thing but we have a little bit of time if anybody wants to throw anything else out.

Guest

"I see a lot of the low and mid-rise options being too uniform. I don't see any mid-rise and lower rise or something… Where you go to your high-rise, you tend to vary the density. When you went to some of those mid-rise and lower rises, they looked like public housing from the sixties." (One respondent agrees.)"

Moderator

We're trying to hit a certain density. It doesn't mean that a site isn't open, and another site is built… The point was just to represent a general density.

"What it does in terms of character reminds me of public housing from decades ago, and I wouldn't like to see repeated."

Guest

"You touched upon some of this in passing comments but I think the issue of parking is so philosophical multifaceted because you have aspects of environmental policy you have aspects of technology you have aspects lifestyle you have aspects of automobile design in terms of sizes of cars and need for space and then the zoning issue."

" I understand in interest of the amount of time we have today you focused sole on the parking deck and its design and placement and so forth but what I'm finding among peers and especially

staff is these discussions are tied into other philosophical values about environment, respecting the environment, in terms of the lifestyle they'd rather spend money on travel to a foreign country instead of money maintaining cars. To me there are so many other facets of this one issue about parking."

It all is a determinate.

Guest

"the simple question of will people own fewer vehicles and use vehicles less I also think you have to look at lifestyle trends and say if that's going down what's going up."

"What seems to be going up is globalization, world travel, destination travel so much of that. People are (inaudible) their income in different ways."

"A lesser percentage is being devoted towards owning and maintaining a vehicle and more towards different lifestyles."

Moderator

You think would tend to make people cluster.

Guest

"Absolutely. Yeah."

Guest

"… All but abandoned suburban development in favor of these town center developments for that reason. That density does it for a certain economy in lifestyle."

"We're dealing with transit-oriented development here. We see a lot of that already occurring. All the development that I basically see commuting on the North Jersey coastline. One town after another. The problem is that infrastructure particularly New Jersey transit even the highway system with that (inaudible) bill. 380 is at maximum capacity they can't take any more traffic. New Jersey transit has not added any more trains in fact they've had to curtail trains. As a 3 time a week New Jersey transit worker. It's gotten to a point where its intolerable and your gut reaction is, we can't take anymore development, take your car. That side of the equation is the other side of the equation."

Guest

"I guess there's an infrastructure bill pending. See where the money gets spent. It's a concern"

"Development is happening because of the nature of it. The nature of private development is happening faster than public sector."

Guest

“On the other hand, should we be building more highways? I don’t know if that is the answer to that. …we shouldn’t be doing this.”

“New Jersey is a special state. More densely populated. It should be easier for other states.”

“There was an interesting statistic this Sunday about the pine area. It constitutes 25% of the state material. If you subtract that from the developable area, it’s even more dense than you think it is.”

Guest

‘Everyone keeps on talking about public transportation public transportation. Last week MTA New York just raised their fees… It’s ridiculous. It’s by October they will be broke again and will ask for more money again.”

Group 3 – Millennial panel **May 15, 2019 1100-130 PM**

Guest

“I thought there was a lot about architecture. And I was thinking too. Initially I thought my reading industry as I was also picturing some of the Public street parking. Because we were talking too much about Public as being building differently. And I see it from a different perspective. As a public key part of just an open space. You actually brought in one of the options, the underground. Which was really moving, really moving.”

“Because that clears the field for more user -friendly citizens to occupy that space. versus, closing shadow cast...”

Guest

“That’s like acceptable to have the best parking typologies you know if you were to add some zip cars it would be a great deal”

Guest

“…how you addressed parking and not only as what it is right now but how it will be in the future. So how can we use this space to appeal to a younger crowd and what’s actually happening in the world. Which is harder, becoming less of something you won’t really need in the future.”

Moderator

“Do you think that’s real?”

Guest

“Yes, I think it is”

Guest

“I say that I still agree with the whole Urbanization of everything together. I do agree with like having other Housing other above ground and underground. Around how do we make our love and earnings like that and everything. But I think that. I feel like it's.”

Guest

“Me and my friend we just love that sound the smell of and everything. The younger generation, they don't care.”

Moderator

“Well you know the advertising is cars are associated with freedom, right. Freedom on the road, cruising on the road. So, there's this whole thing that’s evoked about it. We were all born into that It

Guest

“Goes along with a lot of people's hobbies and things like that too. Going out into the mountains each weekend or something like that. To hike, camp, ski or things like that. It makes having a car a lot easier. When you’re trying to buy slabs of wood”

Guest

“I guess I on that same wavelength. Also looking at like how like just that psychological sort of impacted living instincts. For me like I get overwhelmed when I go to cites, especially New York city. So, I tend to gravitate towards more world environments.”

Guest

“So, what’s tricky is. Rural and urban is really. Especially in America. How many models of cities like New York and Boston maybe you can live in the cities and Manhattan?

Guest

So, all those services and looking locally. And no supermarket nearby. You need to have that context here. I n some places there's no way you can get around and get by in daily life.

The same can be said. People are willing to go out and get to the next stop… … so, they're not necessarily that walkable / American cities.

I mean the European cities started as a model . Makes it difficult to get around for our people”

Guest

I was thinking that while you were presenting and zip car car share. Really candidates right. Do people really use zip car?

Guest

“ Its really a city thing. You know a lot of people in the city, never had a car. So yes, I think.”

Guest

“ It reached out to college campuses too.”

“I know at Lehigh my freshman year the parking lot outside all freshmen dorms they had about five or six Zipcars. That you could sign up for you know a weekend or something, if you wanted to go home. Or do whatever “

Panel 4 - Public officials **July 10, 2019 630 – 900 PM**

Guest

“Can I just throw in a comment here. I'm also a realtor. And I get realtor magazines. And it's just an article that people are not moving to New Jersey because of the trains because they’re so unreliable. So, I think you know in planning these transit hubs. (it’s a real problem) It's something that you'll probably need to be concerned about.”

“Reverting to transit and or all these other options that are going to be available service options that will Uber, Rideshare. And autonomous taxis, all these things that are being talked about. Do you believe that is going to happen? Two is similar do you think that it essentially will eliminate the need for private vehicles as opposed to just simply downsizing the demand. Will we become autonomous gently rideshare People and give up our cars.”

Moderator

“Do you believe that the whole work from home and co work environment thing is going to replace the need to clean”

Guest “That' word replace is awfully strong. That’s a really strong word.”

Guest ‘’It would be a good thing though; wouldn't it be a good thin”

Moderator

“Do you see yourself relocating to a more urbanized setting as opposed to a suburban home as you get older? So, the convenience of living in an urbanized area that doesn't you making it”

Guest

“Yes. So, it does. It doesn't mean Hoboken New Jersey City it could be again downtown Madison. Downtown Chatham Yeah”

Guest **“**A rather than me. We are not going to relocate; we are going to stay where we are”.

Moderator

“Do you see yourself reducing yourself to a single vehicle or less per family”

Guest

“You’re going to take my license away”

Guest

“What have you been up to?”

Guest

“That might happen. I’m not giving it up, though”

Guest

“Now. I go by car. I drive my car once a week to Trader Joe's. (Really?) I walk everywhere”

Guest

“You sound like my wife”

Guest

“That's. Where. You just get in and it takes you wherever you want”

Guest

“I guess that's the hope. And you’re going to share that with 10 other families. Yeah. So, you're never going to own it. You’re going to dial it up”

Guest

“Private ownership is gonna go away, you’re not going to have maintenance issues”

Guest

“Where you park at the end of the day”

Guest

“They're going to worry about it. It's going to get deposed somewhere else and it's going to come to you when you need I”

Guest

Paraphrase from Public officials’ panel. Re. Cost of HUB upgrades.

You’re not looking at total lifetime costs. Cost to build is only one piece of it.

I’m a retired Town Engineer. Life cycle costs is a big factor. How many times does that surface have to be re-lined? Every 10 yrs, every 15 years? If the deck structure’s useful life is 40 years, I guarantee there is a major rehab at least once in that period. This is NJ after all. Snow, rain, ice, road salts, leaks etc. So, if the playing surface has to be re-lined twice, say every 13 years, how does that impact operations and use. And how does that tie up these spaces and for what period.

All of this goes into the consideration of these upgrades. Not just first cost.

Comments on sessions were also received:

A former Chairwomen of a Morris County planning board, remarked: "I love this! Parking is so important and issues surrounding land use for parking". Another local planning board member, "recommends the sessions include other variables such as mass transit". And yet another planning board chairmen from a more urban community remarked, "there is a need for additional open space in urban areas for recreational use for children and seniors" and this member also suggested "designated bike lanes". Finally, when speaking to the focus group experience overall a member remarked "only to clarify that we are speaking in general terms not as a board member approving a project". However, the sessions were "fun and interesting - I love planning".

On another note, a county PB member from an urbanized county remarked "three assumptions re the discussions related to a relocation to an urbanized community – "reduced auto dependency, adopting rise share and public transportation are "radical assumptions" ". This points to the fact that futures trend a cited in the literature and other research studies are anything but certain, and subject to a variety of manifestations, with dependencies that we simply do not have the capacity to understand at this time. Echoing this remark, a retired municipal engineer remarked that "the presentation was well done considering the complexity of the concepts. Simplifying the concepts would help. "

Finally, a former housing authority exec director from a major Hudson County city remarked that all of the following required serious scrutiny. "TOD platforms, density platform and policy, and critical mass planning" The later item suggest that there is a time at which the drive to redevelopment becomes self-sustaining and perhaps overwhelming, the requiring some well thought out controls to assure that city infrastructure is not completely overwhelmed. . (See article: https://www.brookings.edu/opinions/the-2-solution-drawing-a-critical-mass-of-residents-downtown-is-key-to-urban-revival/)

APPENDIX I

Transcripts VPS sessions and Professional Interviews

I - 2 Professional interviews – Individual transcripts

Interview subjects were elected from professional and lay members, sitting in separate sessions. The list once assembled was presented similar reviews of case study analysis and was asked to react to a series of preformatted questions.

The questions covered the full range of the parameters under investigation in this dissertation. An example of questions and points of discussion are included in the parameter / issues chart in the Appendix. These questions formed an outline for a set of future design and development guidelines to be developed with the subject's input. Some subjects were readily able to respond to all aspects of the outline, others more limited in their response given their overall position in the process and/or lack of familiarity with issues related to design and urban design interpretations. The concept of a community-based transportation HUB and the parameters for this prototype as a building standard were also addressed in the interest of presenting an illustrated set of parameters for further examination.

(a) Subject interviews summary

The ten selected subjects were provided copies of the generic cases and detailed site-specific cases studies prior to their session. The subjects were selected for their diversity and individual insight into the area of redevelopment and infill redevelopment programs with special emphasis on parking and the cases at issue. Interviews were wide ranging and tended to stay within individual comfort levels or silos. All input proved valuable and serves as an appropriate back drop with some very specific insights into the issues that surround parking and parking structures in this dissertation

b) Summary, key points, guidelines

Comments and recommendations from interviews – overview of subject comments.

(1) Determining the size and scale of parking amenity in any proposal is very much transactional in nature. A process of negotiation with local town officials, zoning standards and a sense of user demand.

(2) Beyond code requirements is the perception of market and demand that effects absorption, rental rates and economics of the development for the intended target user.

(3) Public parking access is used as a genuine lever in controlling or limiting development activity. Control of volume of community building is a political act and based on a community perception of what is tolerable

(4) The ultimate scale and massing of these structures is a direct offshoot of the factors above and the relative densities being sought in the redevelopment proposal. Of late super densities in excess of 65-75 units per acre and as high as 125 units per acre are being sought in many urban and suburban urban cluster locations which implies ranges of FAR and coverage here to for unseen.

(5) The aesthetics of these buildings are directly related to the style and scale of the accompanying office, retail and residential structures that accompany these parking structures. At a moderate density and scale the aesthetics of the parking structures remain residential and contextual in content. However, as these super scaled developments emerge an entirely new context is being proposed to which these structures must yield to in their style and definition and overall aesthetic.

(6) What the parking industry anticipates? Picture is growth despite downsize of private vehicle ownership as a precursor to Uber ride share and autonomous rising capacity. More diversity of users and infrastructure, demands for extended drop offs, and other accommodations (Atlanta bond ordinance as a reference) Question of who pays? Public or private sector for these infrastructure needs?

Overview - Professional interviews conducted over the course of this dissertation Nov 19, 2019

Comments from parking authority executive director and authority legal counsel

1 As such the sizing and scale were all determined by an interactive process with area land owners/developers to meet their expected demands.

2 In some case landowners were granting/contribution land in exchange for favorable siting and placement. Sometimes at no cost.

3 Condemnation has never been required and would have been a nonstarter.

4 Architecturally decks are simple and straightforward. No integration of mixed uses however they occur in a compact urban setting so by default are integrated to their blocks and contexts.

5 Morristown is aware that building less parking also puts the breaks on development and given scale of build out in recent years there is now a backlash occurring that is driving this scale back trend.

6 Also, aware that Uber is pulling cars from transit. Not reducing demand on roadways. Although ownership of personal vehicles is being affected.

7 Subjects are not clear on what implications of autonomous vehicles will be.

8 Discussion ended with issue of formal planning and design as a part of the process. While professionals are certainly involved they are not driving the resolution which is for the most part a real estate negotiation. I.e. process is very transactional vs a formal linear planning process.

Comments from professional planner

1 RSIS is the default in any suburban location for parking requirements in multifamily housing

Conversation also addressed the transactional nature of these negotiations including developers sense of what a "marketable" unit needs to include including adequate parking accommodations. Given any set of unknowns the reaction is to error on the side of caution, to oversupply. The ability to come back after the fact is limited.

2 At the board level. There is a very narrow window of knowledge and a huge dependence on the municipal retained consultants to point the way,

3 Re: Adapations, uber, autonomous, drop off zones, HUB transit centers, recapture parking as parklets or other redevelopment goals

General reaction was that all of these subtopics and potentials ring true, but in order to engage and have solid traction solid evidence of the specific intervention needs to be

presented. The best-case scenario is an example where these adaptations were executed with catalogued results and performance evaluations.

Professional engineer engaged in redevelopment zones

1 Note lack of any relationship to either density, or distance to transit overall. At min. no consistent pattern emerges while numbers do vary

2 His sense is that the ratios are developer driven, that they desire to have a marketable project first, at whatever the cost, and only second to incorporate the benefits or location or transit access.

3 Noted two phenomena recently. A split between built and unbuilt parking of 50% in urban/transit zones

4 I.e. if municipal parking is available, at least half the requirement going to the public deck, the other half built on site.

5 Lease commitments of a minimum of 10 years are usually required for the public deck substitution but understanding is it can be modified if evident of lack of use is presented and consistent.

6 Likewise, in new developments, not necessarily at transit but adjacent. A pattern of decking 50% on site, the balance in open field lots. In a similar sense, first it saves money, second the implication is that if demand downsizes the open lots are available for future development, i.e. pad site or other related uses.

Executive at NJ Transit involved in acquisitions, dispositions and transit village program

1 Conversation began with addressing NJTs traditional one for one replacement policy for onsite parking as a component of a land transfer for a transit village site.

2 NJT is now interested in re-examining some of these basic parameters of prior policy understanding these protocols in the face of new realities and research. Interested in readdressing these standards and a contemporary take on transit use

3 Considering ride share and autonomous vehicle roll outs they understand that the framework has changed and will continue to change over time

4 Bus transit HUBs are a target for NJT attention. First, they are cheaper, can guarantee a single seat ride to a CBD, while being flexible and re locatable if for some reason they don't work siting wise. Bus malls and bus transit in the California model are very much an objective for future transit rollouts as opposed to hard rail infrastructure.

5 Finally, and we can further discuss if of interest, note that NJT now has a strong preference for making its excess properties available via long-term unsubordinated ground lease (vs fee simple sale). As the value of land holdings proximate to transit is

considerable and projects to grow over time, NJT prefers to participate in the upside that transit service helps create and sustain and generate recurring cash flows to the company

Senior executive - Area developer redevelopment

1 Office. Suburban office specifically. Need to upsize generally to 5 to 6 / 1000 based on current office demands. I know this all too well. Yes!

2 Rental housing. Reviewed of my quick survey. Point made to check actual utilization since your experience in transit friendly Harrison points towards a 0.8 vs provided 1.0 ratio in place. Essentially 20% underutilized. Good point and will follow up on this. Would definitely be interesting to gather the facts on utilization as compared to approved/built.

3 On that note if presented a reasonable conversion plan for parking to office or residential, would you invest the extra dollars in floor to floor heights or deck loading as well as possibly separate express ramp structures in lieu of continuous ramped decks to allow a future conversion? And at what premium. If 25K per for normal in place deck spaces would you go 20% to say 30K per space to assure this future flexibility? Yes, we have talked about this and would be willing to invest more capital into today's garage designs to allow for future flexibility and re-use.

4 And would this be a significant lever to a go/no go decision on a site or opportunity? Incentives can definitely make a difference in decision making on particular opportunities. Developers are always interested in financial and planning incentives.

5 What do you anticipate for suburban clusters / repositioning like you Bridgewater site or the Lanidex site mentioned when together? Although most towns verbally seem receptive to mixed use redevelopment of functionally obsolete or surplus corporate assets, they often struggle with reaching consensus on the mix and density of uses and resulting perceived traffic issues, local school impacts, NIMBY voters, etc.

Legal counsel involved in redevelopment declarations and former state commission chairman

1 Process is really not the issue and there are points of intervention to affect the parking program, and programed into the redevelopment process.

2 With respect to intervention points the first is at the planning board. The biggest issue there is, who generates the redevelopment concept plan.

3 The subsequent period during which a redevelopment agreement is being negotiated with the redeveloper provides the second point of intervention as well the forum to tweak the concept plan.

4 An overall agreement during our discussion, to paraphrase Goldsmith, that parking does set the stage and is an important underlier of what is to come in the overall redevelopment effort. Parking helps set density and the scale and volume of development that is to follow.

5 Concepts that interface with regional planning goals such as RPA's suggested transit HUBs as integrators of transit and ride share have a role to play. However, acceptance of these goals and the concept of an oversized parking structure in a suburban setting to accommodate those aims will have its own local detractors.

6 Concepts that interface with regional planning goals such as RPA's suggested transit HUBs as integrators of transit and ride share have a role to play. However, acceptance of these goals and the concept of an oversized parking structure in a suburban setting to accommodate those aims will have its own local detractors.

Interview synopsis – Subject interviews 1-6 **Dissertation effort June 6, 2018**

Interview 1 and 2, Major parking authority

Parking authority Exec Director and Legal consultant
Exec director does participate in mayors visioning and exec sessions. (EDCis also a past director of Mtn Partnership a business partnership and event promotions that managed a special improvement district for the downtown area)

Legal consultant is a significant author and consultant to authorities in other major cities around the state. Hoboken. Princeton. Rahway. Etc.

Town is aware that parking enables and can at the same time restrict growth.

Prior decks.

Schuyler/Bank St. (free standing with an air rights transfer for a free-standing office building).

Cattano. (free standing with street frontage but integral as a mid-block feature to adjacent uses / frontages)

DeHart. (wrap around but without direct access to all adjacent uses, but major component of a redevelopment district bound by four adjacent streets)

And pending lot 10 (freestanding mid-block).

All envisioned to enable redevelopment for various sectors/districts.

As such the sizing and scale were all determined by an interactive process with area land owners/developers to meet their expected demands.

In some case landowners were granting/contribution land in exchange for favorable siting and placement. Sometimes at no cost.

Condemnation has never been required and would have been a nonstarter.

Towns 60's era urban renewal effort at Headquarters Plaza project set the tone for this.

Architecturally decks are simple and straightforward. No integration of mixed uses however they occur in a compact urban setting so by default are integrated to their blocks and contexts.

Current planned deck has been downsized from original planned scale and capacity.

Morristown is aware that building less parking also puts the breaks on development and given scale of build out in recent years there is now a backlash occurring that is driving this scale back trend.

Formal planning process has occurred for the most part, but process has been very iterative with negotiations of final form and approach determined by rivaling factions and interests to a final solution and determination.

Finally. Looking ahead to a downsized/downscale parking demand.

Subjects are not clear on what implications of autonomous vehicles will be.

Comment made that if disabled (blind and impaired) will have access then even more cars will be on the road. 20% factor was thrown out.

Also, aware that Uber is pulling cars from transit. Not reducing demand on roadways. Although ownership of personal vehicles is being affected.

Note. Hertz has a drop off at HP. Could be interpreted as an indication of a future fleet/ ride sharing apps to come.

Additionally, authority has no electronic inventory system/app. in place. Nor app to determine vacancy and direct drivers to available empty inventory therefore implying a reducing needed capacity by increasing usability/efficiency of use.

Need to revisit issue of design of parking to address a reduced demand. I.e. flat plates and height and loading capacities that would address a conversion of structures to alternate uses. Are future conversions even a consideration?

Recent promised corporate users in downtown setting are demanding more parking not less. Recent major accounting firm requirement for a 120-150K build to suit demanded 3/1000. While an urban setting is being sought, suburban parking standards are a part of this requirement

A similar user a few years prior did project a 50/50 mix of commuter's vs parking requirement, but that user opted to stay in a suburban location

Discussion ended with issue of formal planning and design as a part of the process. While professionals are certainly involved they are not driving the resolution which is for the most part a real estate negotiation. I.e. process is very transactional vs a formal linear planning process.

More thoughts on this subject to follow and about what venues or formats would allow a more directed effort at design options and the consideration of alternate models with more tailored outcomes i.e. addressing issues of massing, sizing, height, aesthetics, and placement along with issues of integration including pedestrian and streetscape/frontage issues

GJK. June 6, 2018.

Interview 3 – Prof planner **Dissertation effort** **July 2018**

Local professional planner with direct experience in multi-family and infill design

Discussion related to two principal topics

Standards in place

Ability of citizen boards to adjust and adopt new thinking

1 RSIS is the default in any suburban location for parking requirements in multifamily housing

Conversation also addressed the transactional nature of these negotiations including developers sense of what a "marketable" unit needs to include including adequate parking accommodations. Given any set of unknowns the reaction is to error on the side of caution, to oversupply. The ability to come back after the fact is limited.

And time is of the essence, the perception that getting thru the process is the first and foremost concern, without being bogged down on any issues.

I.e. To keep it simple do not introduce complicated argument nor subtle or linked

Interpretations – they only result in delay the in ability to get thru the process cleanly

2 At the board level. There is a very narrow window of knowledge and a huge dependence on the municipal retained consultants to point the way,

A series of seminars acquainting board members with implications of millennial life style patterns, Uber and autonomous vehicle adoptions would prove of merit, but absent actual proven standards the range of commitment to these clear changes is likely limited at least at this time.

3 Introduced a short overview discussion including of several adaptations that may grow out of autonomous vehicle systems (see draft discussion article attached with illustrations)

A Substantial drop off zones in downtown zones including larger venues

B ROW recaptured. The reduced density of traffic implied and the termination of private on street parking in neighborhoods implies an ability to reclaim street spaces for recreation, bikeway, street fairs, and dedicated autonomous drop off zones

C Parking deck conversions and tear downs. Implications of less vehicles on the road Includes the demand for dedicated autonomous depots. However, their placement is now linked to other autonomous shuttle systems and may or may not include a transit linkage

D HUB centers with associated community services is another potential outgrowth and this concept is explored as well as. Examples of these sites are presented as well.

4 General reaction was that all of these subtopics and potentials ring true, but in order to engage and have solid traction solid evidence of the specific intervention needs to be presented. The best-case scenario is an example where these adaptations were executed with catalogued results and performance evaluations.

However, forming a program and conducting a continued seminar addressing these future adaptations are definitely good food for discussion with local boards that would gain audience

A trial balloon perhaps with a single town, to test the waters might make sense.

DISCUSSION WAS LEFT AT THIS LEVEL WITH A RETURN SESSION PROPOSED AFTER SOME

REFLECTION AND CONSIDERTION

GJK August 1, 2017

Interview 4 – Professional engineer **Dissertation effort** **July 2018**

Local professional engineer with direct experience in multi-family and infill design – SO, Rahway, etc.

Discussion related to two principal topics

Standards in place – Implementation vs RSIS standards in multiple bldg. types

Presented attached local survey of parking requirements at area multi-family developments recently approved

Interviewee was the professional engineer and traffic consultant for half of the projects detailed.

Note lack of any relationship to either density, or distance to transit overall. At min. no consistent pattern emerges while numbers do vary

His sense is that the ratios are developer driven, that they desire to have a marketable project first, at whatever the cost, and only second to incorporate the benefits or location or transit access.

Sense was a belt and suspender kind of approach, assure marketability at all costs. And if that means parking goes unused then so be it. The ability to rent is based on a perception first and foremost, whether the accommodation or amenity is in fact ever utilized.

Noted two phenomena recently. A split between built and unbuilt parking of 50% in urban/transit zones

I.e. if municipal parking is available, at least half the requirement going to the public deck, the other half built on site.

Generally, 1/unit on site, and 1/unit or fraction there of remote. Towns are allowing this first because the public deck now servers more developments rather than 100% of fewer, an accommodation to a 1.0 ratio is buffered by the overflow to the municipal deck, where if not utilized can be reallocated over time to other users, reserving whatever fraction of the second 1/1000 for the developers use.

Lease commitments of a minimum of 10 years are usually required for the public deck substitution but understanding is it can be modified if evident of lack of use is presented and consistent.

Likewise, in new developments, not necessarily at transit but adjacent. A pattern of decking 50% on site, the balance in open field lots. In a similar sense, first it saves money, second the implication is that if demand downsizes the open lots are available for future development, i.e. pad site or other related uses.

Introduced the same draft article concerning future autonomous implications

Much less engaged in this line of thinking, no sense of an appeal to local boards or professional or town engineers.

Frankly has not thought about it enough, though he is engaged in almost every active City experiencing redevelopment programs

Rahway, Morristown, South Orange, Maplewood, etc., etc.

SUGGESTED A RETURN VISIT TO EXPLORE SOME OF THESE IMPLICATIONS AFTER READING THE ATTACHMENT MORE THROUGLY AND THINKING ABOUT THE SUBJECT FURTHER

GJK August 1, 2018

Interview – 5 NJ Transit official **Dissertation effort** **Sept 2018**

is the director of real estate dispositions for NJT and so in a pivotal position to NJTs transit village program

Conversation began with addressing NJTs traditional one for one replacement policy for onsite parking as a component of a land transfer for a transit village site.

NJT is now interested in re-examining some of these basic parameters of prior policy understanding these protocols in the face of new realities and research. Interested in readdressing these standards and a contemporary take on transit use

Considering ride share and autonomous vehicle roll outs they understand that the framework has changed and will continue to change over time

Also introduced a preliminary survey and graphic model of parking ratios in relationship to transit access and proximity to illustrate the kind of direct research being offered in this dissertation, copy enclosed. Shared parking ratios also discussed in this respect as a means to reduce ratios overall and therefore effecting demands for a one on one replacement program at transit villages.

Additionally, it is oficials feeling that NJT should be addressing issues in Smart Growth in these developments. I.e. live work, reduced commutation demands for workers with flexible work schedules understanding that the 9-5, 5-day work week, is adapting to a different pattern that impacts ridership and transit use.

It's difficult to launch these initiatives in an agency starved for funding where every asset conversion demands maximum returns.

Brought us to the question of extreme densities being proposed at Broad Street Newark (GK Case 1) and likely at Metro park (GK Case 2). Reduced parking ratios that become the basis for incredible density yields more than 45-50 units per acre, in fact ranging to 65 to 75 or more with FAR ratios of more than 9 or 10.

Reduced parking ratios are having a reverse effect with respect to the mass and scale of these redevelopment options / proposals.

We addressed RPA urban cluster recommendations of the 1990s citing any zone or site with connectivity as a target for these kinds of super densities.

Parsippany, Lanidex site an illustration in this regard (GK Case 3). Point of discussion with its location at a highway interchange at Rt 80 and 287 and fits the RPA model. In that instance with densities more than 50 and FARs over 6 to 7 with only park and ride transit access

Bus transit HUBs are a target for NJT attention. First, they are cheaper, can guarantee a single seat ride to a CBD, while being flexible and re locatable if for some reason they don't work siting wise. Bus malls and bus transit in the California model are very much an objective for future transit rollouts as opposed to hard rail infrastructure.

Mentioned NJTs expansion service map. Extensions from South Trenton to the Raritan Valley Line via Hillsborough and Somerville as well as extension of Morristown Dover Line to Roseland thru Whippany. Mentioned clients who would benefit either abutting or proximate to these extensions

Other assets and other models were discussed including transit HUBs with depot accommodations and mixed-use solutions Re Madison Transit Plan with a mixed use, depot type structure with recreation above as a viable model but requires local initiatives and visioning. NJT simply does not have the resources to lead these efforts in the face of home rule and the dominance of local politics in these undertakings.

Again, bus malls and HUBs are a definite target for these cases where hard rail is unlikely to emerge in the foreseeable future.

But would NJT embrace programs of this sort - answer is a definitive YES in the right context. But the urgency of their financial position forces them to focus on operations and investments that support day to day operational efficiencies and funding

Paralleled the case of the Newark archdiocese whose extensive real property assets are at risk, and hungry for re envisioning and re positioning programs for these resources. Alternative is to preserve assets much as the archdiocese does thru short term leases to stabilize and assure they don't deteriorate through vacancy and the then normal course of disuse and lack of maintenance.

Visioning and re invention opportunities abound for a list of assets which deserve much more attention than they now get. A subject to visit at an appropriate point

I mentioned that the development of some of the dissertations models and prototypes might ease this process as individual future sites come under consideration. Adapting these models in different contexts are easily translated and adapted.

We closed with this importance of transitions in the larger picture of mobility as an on-demand service impacts all assets and drives a future reinvention process.

Drop off and queuing zones alone for example require a major reinvestment just to accommodate a future autonomous and Uber roll out a transit head. In and of itself not a minor demand and a definite need currently and in the near and immediate future

GJK Sept 11, 2018

Update response Sept 2019

George,

Thanks for the files, look forward to reviewing. Appreciate the summary notes.

Finally, and we can further discuss if of interest, note that NJT now has a strong preference for making its excess properties available via long-term unsubordinated ground lease (vs fee simple sale). As the value of land holdings proximate to transit is considerable and projects to grow over time, NJT prefers to participate in the upside that transit service helps create and sustain and generate recurring cash flows to the company. This directly ties into the funding challenges we discussed, and the notion that NJT has to help support itself where possible. Additionally, it affects structured parking pro formas, and reinforces the notion that these facilities have to be flexible, right-sized, priced to reflect the true cost of auto storage, and capable of integrating (and evolving) with the macro changes you reference.

Any questions or points to further explore, please call. Appreciate the opportunity to be involved with your project.

Subject Interview – Senior offiicer, Realty Dissertation effort Sept 2018

realty is a major player in redevelopment in northern NJ, COO

Office. Suburban office specifically. Need to upsize generally to 5 to 6 / 1000 based on current office demands. I know this all too well. Yes!

Rental housing. Reviewed of my quick survey. Point made to check actual utilization since your experience in transit friendly Harrison points towards a 0.8 vs provided 1.0 ratio in place. Essentially 20% underutilized. Good point and will follow up on this. Would definitely be interesting to gather the facts on utilization as compared to approved/built.

With respect to Uber and ride share and future autonomous vehicles "It may be coming but integration is not clear nor timing". Assume then at the moment you are not adjusting entitlements in this regard. That you will deal with it when and if it has a substantive impact. Although we would like to adjust entitlements in anticipation of changing use of cars/rideshare/mass transit, the towns are slower to adapt and approve. Should happen in time but will take some data to support it.

On that note if presented a reasonable conversion plan for parking to office or residential, would you invest the extra dollars in floor to floor heights or deck loading as well as possibly separate express ramp structures in lieu of continuous ramped decks to allow a future conversion? And at what premium. If 25K per for normal in place deck spaces would you go 20% to say 30K per space to assure this future flexibility? Yes, we have talked about this and would be willing to invest more capital into today's garage designs to allow for future flexibility and re-use.

Finally. We all know the redevelopment process is expensive. I.e. assemblage clean up, extensive on-site demo etc.

In what ways are you being incentivized monetarily at this stage on the local or state level and does any of this funding extend to basic infrastructure including parking? Although not specific to parking incentives, the best current incentives for redevelopment is the use of PILOT programs to reduce and fix property tax amounts and risks for the developer.

And in what form. I.e. low interest loans, direct grants, tenant rent subsidies, other? Or the entire or partial structured parking burden being assumed by municipality as an incentive to acquire and proceed? See above answer

And would this be a significant lever to a go/no go decision on a site or opportunity? Incentives can definitely make a difference in decision making on particular opportunities. Developers are always interested in financial and planning incentives.

Certainly, we are aware that some of this has been legislated for urban sites.

What do you anticipate for suburban clusters / repositioning like you Bridgewater site or the Lanidex site mentioned when together? Although most towns verbally seem receptive to mixed use redevelopment of functionally obsolete or surplus corporate assets, they often struggle with reaching consensus on the mix and density of uses and resulting perceived traffic issues, local school impacts, NIMBY voters, etc.

Sources, denominations, i.e. as a percentage of improvements? Any parameters out there that are meaningful? And what we can be anticipated down the road?

Looking ahead also.

Given the wide span of product types that in fact participates in.

What level of discount do you consider a reasonable basis to acquire these kinds of larger redevelopment sites? Without being evasive, the answer really depends on the carry costs, the potential re-use of any of the existing infrastructure, the environmental condition, the uses, the supply/demand and market rates for uses being considered, etc. Sorry can't be more specific, but it is really project specific.

I mentioned an acquisition of 38 acres at 7.0 mil and essentially 350,000 sf. That's approximately $20/sf for a site with a 0.20 FAR in place.

Can you say with some certainty that the push for extra FAR or density increases needs more than double or triple on that basis i.e. a 0.8-1.0 FAR final yield with an equivalent density north of 40 units per acre?

That's based on a current .20 FAR ratio in place of course included all onsite parking.

Given that context would you risk even 50% structured parking at a 50% ratio to support this kind of density?

Simple numbers might be.

45 units per acre. 68 spaces at 1.5 ratio. 34 surface, 34 structured at 22K per.

That's 750K per acre and 26.3 mil. over the entire tract to support the density increase of this magnitude. 1500-1600 units over 35 acres final yield.

Realize this is all in the abstract but if you have a sense of it please give me your impression. And I realize it all comes down to rental rates. But assuming a final monthly 1-bedroom rate of $2800-3000. Is it something in the realm of the possible?

And if the req parking ratio dropped to half or .75 per unit. Could you see a rental rate south of $2500 or $30.00/gross working with a 50/50 split structured to surface.

I know that one is a little too difficult to opine on but give me an impression of the break points if you have an idea. This is hard for me to be specific about, as you can imagine the number of variables and project/location/market specific underwriting impacts, Hard to apply "rules of thumb" to much of this.

Finally, I sent you a disclosure form a month ago or so back, stipulating that this interview and your comments were to be unattributed in its final form

So, I'm reiterating that again here, but if on the other hand you are comfortable being identified or want to censor any of the responses please just let me know. I am OK either way. If you think it adds value for you to include specific names/references, feel free to do so.

I'm sure you understand these kinds of impressions are difficult at best to assemble so I really appreciate you letting me volunteer your time for this.

GJK September 19, 2012

Interviews 7, 8 and 9 **Dissertation effort** **Summer 2019**

Interview 7 Industry consultant and speaker

Phone interview regarding her "Game changers" session at the IPA convention, and oveall subject is future of mobility and her remarks at that session. Inserts in LR reflect her remarks

Interview 8 Academic with significant published research in subject area

Phone interview regarding her book *Parking Structures: Design and Evolution of Modern Urban Form.*

Larger discussion about her current research, which as well looks at new modes of mobility and their impacts on not just parking structures but other urban systems. Extended interest in what cities are doing and their approach to down sized demand.

Referenced to: Washington state located parking consutancey who is tracing these changes

TRANSPO GROUP in Kirkland, WA.

https://www.transpogroup.com/

a recent analysis of Seattle parking status is below

https://www.seattle.gov/dpd/cs/groups/pan/@pan/documents/web_informational/p2648152.pdf

and to

Other sources she will provide to access actual scale and size of parking structure construction in industry on an annualized basis.

She admits that there is in fact no central source for this information.

Relayed my attempts to assess this from the stats contained in the MBA recent study but that the projections were quite open ended.

Interview 9 Executive director, Smart growth agency, Form based code related

Brief discussion about status of guidelines and standards in FORM based model codes. Noted that Emily Talen is conducting an ongoing assessment of form based codes and their range of subject matter.

Offer to provide final outcomes of this dissertation effort for staff review and potential inclusion in an overview amendment or article for publication.

Interview 10 - RE attorney, extensive redevelopment credentials **October 2, 2019**

Dear ,

Thanks for the time this morning. Beyond this it was great catching up.

Sorry I couldn't buy you breakfast but maybe dinner one night if you have the time.

GJK

My takeaways from our talk:

1 Process is really not the issue and there are points of intervention to affect the parking program, and programed into the redevelopment process.

Not mentioned - but clearly the level of angst and overall controversy level is upped in the declaration of an area in need of redevelopment vs rehabilitation simply because of the condemnation issue.

2 With respect to intervention points the first is at the planning board. The biggest issue there is, who generates the redevelopment concept plan.

A If city based there is adequate time in a pre-redevelopment stage to conduct visioning sessions with stake holders and to articulate directions and balance the interests of residents, property owners and developers.

B However, if developer based the constraints on the planning board review are "compliance with the terms of the city's published master plan" with only a 45 day period granted to accept or reject that submission. That time line could be problematic depending on the scale of the redevelopment zone.

3 The subsequent period during which a redevelopment agreement is being negotiated with the redeveloper
provides the second point of intervention as well the forum to tweak the concept plan. The obligations falling out of the overall general redevelopment concept plan are resolved there. This is a point in which there is an opportunity to dig in.

It does need to be stated that parking is but one item on a list of over forty line items (referencing your redevelopment practice guide publication) that require resolution. The implication of this is that the band width for attention to parking as an issue is limited given the complexity of the negotiation process.

4 An overall agreement during our discussion, to paraphrase Goldsmith, that parking does set the stage and is an important underlier of what is to come in the overall redevelopment effort. Parking helps set density and the scale and volume of development that is to follow.

5 Concepts that interface with regional planning goals such as RPA's suggested transit HUBs as integrators of transit and ride share have a role to play. However, acceptance of these goals and the concept of an oversized parking structure in a suburban setting to accommodate those aims will have its own local detractors. Issues like traffic and congestion, and typical NIMBY responses, will be a factor as local streets are viewed as the overburdened to accommodate the kinds of movements implied by this approach. The ultimate settings elected and site choice for these intermodal centers become an important point of decision.

6 Finally and importantly, there is a larger role and responsibility for professionals on both sides of the transaction. Lawyers, planners, architects and others play a huge role in articulating the possibilities and the vision of any plan, as well as the list of options and alternates that can be considered.

For parking and parking structures, the intersection between issues like parking ratios, shared use, ultimate entitled FARs and the issues of sizing, scale, etc. of the final form need to be negotiated and entitled in that forum before they become elements for public debate and review. This implies also an effort to educate and inform public board members, not necessarily familiar with these issues to be mentored in order to improve the quality of the dialogue.

In all of this though, it is clear that professionals are constrained by their fiduciary to their client's interests and intended program, and that as well underlies the process and the range of options that can be considered and explored.

Thank you again, would like to use some of this with or without acknowledgement so please strike anything above that you might be uncomfortable with. BTW, this session falls under RU protocols for anonymous interviews so it is the intent to integrate these points of discussion without direct credit. Your choice of course.

GJK October 2, 2019

APPENDIX J

VPS Session Protocols

J - 1 Focus groups – Outline

Introduction letter and overview

Thank you for agreeing to participate in this focus group. This represents but one part of a larger research effort being conducted in the context of an academic dissertation at the Edward J. Bloustein School of Urban Planning and Public Policy at Rutgers University.

The dissertation examines structured parking in the infill development/redevelopment settings, focusing on the specific issues surrounding the physical planning of these structures in the city space. It also considers issues that include public policy, engineering and technical constraints, and larger definitions in urban design and architectural theory.

The focus group is structured in the form of two 90-minute (maximum) sessions. We will break for a light lunch in between the two.

I promise to keep the discussion lively an on-point. Your specific expertise in your area of specialty is important to the task at hand. I truly appreciate your commitment to participate in this session.

The attached set of exhibits serve as pre-reading to serve to prepare you for our discussions. They represent the framework and tools that we will use during the session. Please take a look at them before coming to the group — it shouldn't require more than 30 minutes — so we can hit the ground running.

Thank you for your interest, and your willingness to participate in this research effort. I hope the outline below provides you with a good sense of what is being requested of you.

Please let me know if you have any questions, particularly with regards to any of the topics covered in the exhibits.

Very truly yours,

GJK

Focus Group Topics and Agenda (Research questions stated in simple form)

The larger research effort examines structured parking in infill development/redevelopment settings, focusing on the specific issues surrounding the physical planning of these structures in the city space. As part of our examination, we will focus on structured parking in terms of five key physical attributes:

- Sizing
- Scale
- Massing
- Aesthetic and visual representation/treatments
- Placement

We will also consider the impact of broader issues related to structured parking:

- Public policy
- Smart growth
- Engineering and technical innovations
- Urban design and architectural theory

Finally, you will be asked to consider the role these structures may play in the future, and how they can be adapted or refit to other uses based on a series of trends emerging in mobility, settlement and overall demographics.

Focus Group Agenda

Session 1

1. Review and score on a five-point scale generic examples of structured parking.

2. Using the scoring results from above, we will have a moderated discussion concerning the definition of each area of interest.

3. Review, and conduct a similar evaluation, of six generic prototypes representative of different approaches to structured parking. The evaluators address the five key areas of inquiry discussed above, although at a finer level of detail.

Lunch Break

Session 2

1. Viewing of a video simulation of a generic downtown redevelopment zone that incorporates all six of the prototype approaches to structured parking. You will be asked to consider and comment on your prior evaluations of the prototypes in this specific context of the downtown setting presented in the video.

2. Using the same list of detailed evaluators from the morning session, you will be asked to score case examples that show the prototypes deployed in three different development settings.

3. To conclude, we will have a wider-ranging discussion is planned focused on future trends and their potential impact on the issue of structured parking. Addressed in the pre-reading for the session, the trends include transitions in mobility, demographics, and settlement patterns.

We will use two different models to frame our discussion: a proposed transit mall in a typical Main Street, and conversion options for typical parking structures to alternate future uses. In both instances, the myriad practical considerations and financial costs of planning for these future adaptations will be addressed.

Final Thoughts and Wrap

APPENDIX J

VPS Session Protocols

J – 2 IRB for Anonymous Data Collection Form

CONSENT FORM

FOR ANONYMOUS DATA COLLECTION

You are invited to participate in a research study that is being conducted by George J Kimmerle, PhD qualified who is a _student in the Edward J Bloustein School PhD program at Rutgers University. The purpose of this research is to determine _response to case studies, for PhD dissertation work

This research is anonymous. Anonymous means that I will record no information about you that could identify you. There will be no linkage between your identity and your response in the research. This means that I will not record your name, address, phone number, date of birth, etc. There will be no way to link your responses back to you. Therefore, data collection is anonymous.

If particular comments are to be attributed then that will only occur with your specific and written authorization.

The research team and the Institutional Review Board at Rutgers University are the only parties that will be allowed to see the data, except as may be required by law. If a report of this study is published, or the results are presented at a professional conference, only group results will be stated. All study data will be kept for *2 years.*

There are no foreseeable risks to participation in this study. In addition, you may receive no direct benefit from taking part in this study.

Participation in this study is voluntary. You may choose not to participate, and you may withdraw at any time during the study procedures without any penalty to you. In addition, you may choose not to answer any questions with which you are not comfortable.

If you have any questions about the study or study procedures, you may contact myself at gk@kimmerle.com. You can also contact my faculty advisor Professor David Listokin, PhD at listokin@rutgers.edu,

If you have any questions about your rights as a research subject, please contact an IRB Administrator at the Rutgers University, Arts and Sciences IRB:

Institutional Review Board
Rutgers University, the State University of New Jersey
Liberty Plaza / Suite 3200
335 George Street, 3rd Floor
New Brunswick, NJ 08901
Phone: 732-235-2866
Email: humansubjects@orsp.rutgers.edu

Please retain a copy of this form for your records. By participating in the above stated procedures, then you agree to participation in this study.

For IRB Use Only. This Section Must be Included on the Consent Form and Cannot Be Altered Except For Updates to the Version Date.

Document Version: v1.0

APPENDIX J

VPS Session Protocols

J - 3 Exhibit – Criteria Definitions

The following definitions will provide the framework for our discussions. The five key areas of inquiry are addressed: Sizing, Scale, Massing, Aesthetics or Visual Representation, and Placement

Definitions

Sizing

Size (1) **and Capacity (2)**

Size

- physical magnitude, extent, or bulk : relative or proportionate dimensions
- relative aggregate amount or number
- considerable proportions

Capacity

- the potential or suitability for holding, storing, or accommodating i.e. a large seating capacity
- the maximum amount or number that can be contained or accommodated

Scale

Scale (1) and proportion in art (2)

Scale

- refers to the size of an object (a whole) in relationship to another object (another whole)
- In art the size relationship between an object and the human body.
- In experiencing the scale of an artwork, we tend to compare its size to the size of our own bodies i.e. human scale.

Proportion

- Refers to the relative size of parts of a whole (elements within an object).
- We often think of proportions in terms of size relationships within the human body

Massing

- Refers to the structure in three dimensions (form), not just its outline from a single perspective (shape).
- Massing influences the sense of space which the building encloses and helps to define both the interior space and the exterior shape of the building.

- The creation of massing, and changes to it, may be additive (accumulating or repeating masses) or subtractive (creating spaces or voids in a mass by removing parts of it).
- Massing can also be significantly altered by the materials used for the building's exterior, as transparent or layered materials are perceived differently.

Aesthetics - Visual treatment/presentation

- Aesthetics also esthetics plural in form but singular or plural in construction: a branch of philosophy dealing with the nature of beauty, art, and taste and with the creation and appreciation of beauty
- A particular theory or conception of beauty or art : a particular taste for or approach to what is pleasing to the senses and especially sight...
- Aesthetics also esthetics plural : a pleasing appearance or effect

Additional definitions and characterizations related to visual treatment

For purposes of this research effort visual expressions are classified as follows:

- Rationalist or modernist: linked to high-tech expressions
- Traditional or classical: reductive historic facsimiles, including postmodern applications
- Brutalist or structuralist: generally expressive of the building's constructed or sculptural form. Tectonic approaches to constructability are included here
- Sustainable: reconstructions and those linked to critical regionalism
- Original, or of an individual expressiveness, including deconstructionist forms

Placement

- The act of placing or the state of being placed i.e. in the city grid
- Arrangement or position with respect to other routes of travel
  - Vehicles - both private, livery and ride share
  - Buses and jitneys
  - Pedestrian movement including cyclist
  - Future autonomous routes of access and storage
  - Concerns for safety, cross walks, queuing areas and other areas of hazard
- Placement with respect to major nodes or connectors in the city space, points of focus and visual prominence

APPENDIX J

VPS Session Protocols

J – 4 Summary – Themes

1. Public policy.

A. Parking has a direct impact on densification and urban redevelopment. It is often unappreciated as the device that unlocks density in central city, suburban downtown, or exurban clustered settings.

How does this occur, and how can it be integrated in terms of the five areas of interest?

B. A link to transit is a consistent theme in public policy.

How succinctly does this occur, and what more can be done to provide this meaningful connection?

What form can this take in future adaptations, i.e. Transit HUB designs, etc.?

C. Zoning standards ignore fundamental ground rules for implementing structured parking according to the five areas of interest.

How can zoning regulations enhance and embrace the five areas if interest in parking implementations?

2. Engineering and management.

A. Parking is defined as infrastructure, and nothing more. Its definition is limited to ramps, grades, circulation patterns, capacity, and turnover calculations.

How does this narrow conception and limitation impact and constrain the five areas of interest?

B. Management techniques can limit overall demand for capacity by making parking more efficient. These techniques clearly impact sizing.

What other areas of interest are impacted?

3. Architectural design theory versus urban design theory .

A. As architecture, the parking structure is seen as either a rationalist sculptural experiment, with no link to design traditions, and undeserving of higher standing; or **As a decorated box** whose cladding is ornamental, contextually determined and/or somewhat arbitrary, i.e. not derived from the form itself.

B. In the context of **urban design and planning**, parking can be an appendage of larger scale developments. Its role is secondary however and can be subsumed in the overall project program.

> Can a hierarchy/importance, placement or a role in terms of arrival, entry, or gateway be enhanced by how parking is incorporated into larger development programs?
>
> Can this point of view improve parking on an individual basis as well in a larger city plan?
>
> How do our limitations of understanding regarding parking's role in this respect impact implementations when viewed from the five areas of interest?

4. Other peripheral themes

A. Demographics

Private vehicle ownership, and use, is not a priority for Millennials; as a result, they do not perceive parking as a valuable asset and amenity.

> Will lower demand and service offerings suffice long term and ultimately replace structured parking?

B. Transitions in mobility

These trends point to a far-off future. But developers want to keep ahead of such a change by investing in features that anticipate how the structure will be used in the future.

> How practical is the investment? How certain are we of these transitions to a car-less future?
>
> What practical transitions in use are anticipated for structured parking? Residential, storage, office, recreation, and other uses to be imagined.

C Future settlement patterns

Related to the issue of densification of urban areas, suburban downtowns and ex urban clusters. Many times, these new development scenarios are co-located with transit amenities, sometimes they are not. The conversion of suburban office and retail malls to mixed use communities is a part of this pattern as well.

> How and in what ways are the demands for private vehicles and subsequent parking facilities including structured parking going to be mitigated in these settings?
>
> In a perfect setting the following trends will contribute to a downsize demand. What are the potential outcomes to be anticipated in that case and how reliable are the projections falling out of those projections now an in the near and far future?

- Private vehicle usage
- Jitney and bus transit
- Mass transit
- Autonomous vehicle integration
- Co work on site situations
- Work from home situations / tele commute
- On site employment

APPENDIX J

VPS Session Protocols

J - 5 Protocol for VPS sessions

Focus group outline and list of questions	**GJ Kimmerle** **RU Bloustein School**

Focus group location _____

Date _____

You name _____

Focus group panel participation _____ Architects _____ Attorneys/Profess

_____ Lay public _____ Elected officials

Comments: _____

_____

Note **RU-IRB protocols will be adhered to in these sessions, including protecting the individual identity of the members of the panels conducted. This is an anonymous subject/interview session.**

RU - IRB stands for Rutgers University Institutional Review Board who reveiws all human research protocols prior to administration.

Anytown USA redevelopment program

Part 1. Focus group. Structured parking in an infill setting

Redevelopment program. Anytown USA

Anytown USA has proposed a redevelopment program for a six-block downtown area within walking distance to its commuter rail station

You are invited to evaluate potential approaches to six available parcels as a part of this private and public redevelopment programs

Potential infill options include residential, office and retail mixed use structures as well as traditional parking structures with associated recreation and other public uses.

Anytown is prepared to address parking requirements in the zone from a variety of approaches

Those approaches include direct investment in traditional parking structures in several forms as well as addressing parking through private development efforts in several models.

Evaluating these several approaches and their ultimate impacts on downtown Anytown is the objective of this first focus group session.

These potential parking solutions will be viewed from several points of view primarily focused on their physical design characteristics. Those criteria include. Sizing, scale, massing, aesthetic representations and their placement in the city space. Along with these criteria, questions will address several generic operating and economic questions as well.

Video presentations of the pre-development and post development condition in Anytown will be shared to help you evaluate these options.

Two general approaches are being proposed.

1. Traditional parking programs as we have come to know them and includes freestanding parking structures and subgrade parking garages with a series of alternate features, upgrades and accommodations.

These structures will be built with public funds and the relative costs of these structures and these options will be identified as we review these alternatives.

The cost of building and operating these buildings will be borne by the city and funded by taxpayers, commuters and user parking fees.

2. Structured parking integrated into the various mixed-use redevelopment programs proposed is another approach being considered. In this case parking will be constructed with private funds as components of these proposals.

In that case the cost of the parking component of these buildings may be prorated into tenant rents and it is expected that the cost of parking will represent approximately 20% of the face rents for retail, office and apartments tenants.

Six sites are available for development and the following options are being pursued.

1. Publicly built and operated parking structures.

1A. A traditional multi story parking deck of five levels to be placed at the end of a central block in the redevelopment area. These spaces are for public use and are intended to help jump start individual upgrades and conversions of the existing core of commercial properties in the district. A series of alternate architectural treatments for this structure will be considered and evaluated by the group.

1B. A public subgrade parking garage of either a traditional or robotic format is another alternate . If a mechanical system is elected, it is expected that the capacity of the garage will be increased multi fold. The site will accommodate several access bays for retrieving vehicles and that approach will allow over two thirds of the site to dedicated to public uses. An open public square or passive park are two alternatives being considered for that area of the site.

1C. An above grade parking deck similar in dimension to option 1A is being proposed for a site adjacent to the downtown railroad and transportation center. This structure will include roof top recreation fields and ground floor retail uses. It is the intention of the city to extend the use of this structure to assure it is active throughout the day and into the evenings. When not being used by commuters the parking spaces in the deck will be available for parents and users of the athletic facilities at night and on weekends.

The options listed above and below have been developed to conform to downtown redevelopment guidelines including setback, base height and sky plane regulations for both narrow and wide streets in the downtown area. The details of these approaches will be apparent as the video presentations are viewed.

Note : Each of these options are based on a generic layout which optimizes efficiency while providing maximum yield. They consist of a 200' x 250' footprint and include three lanes, the center of which acts as ramp or speed ramp depending on the configuration. The three-bay parking deck is considered one of the most efficient models for layout and circulation purposes and includes 100-150 spaces per level. A five-level parking deck in this configuration will total 500 - 750 spaces. An additional advantage is that all exterior levels remain flat and horizontal while the ramped portion of the deck remains internal and concealed.

2. Privately built and operated structured parking built as a component of mixed use development sites planned for the zone.

2A. A wrap around multi-story residential structure consisting of the following is one option. A central two-story parking deck is to be topped with a recreation deck for tenant use. The wrap around portions of the structure consists of two retail/office floors over which four levels of residential apartments are set.

Parking consists of 180 spaces both self-access and tandem for 96 residential units and 15,000 SF of retail and office users. The corresponding ratios equal 0.8 spaces for a 1-bedroom unit, 1.6 spaces for a 2-bedroom unit and 3 spaces per 1000 sq. ft of retail and office space.

2A. A multi-story podium residential structure consisting of the following is another option. A single story partially buried parking deck topped with a recreation deck for tenant use is a feature of this option Four levels of residential apartments are set above the podium with a 5th floor, 5,000 sf amenity structure, at roof top.

Parking consists of 90 spaces both self-access for 120 the residential units. The corresponding ratios equal 0.8 spaces for a 1-bedroom unit, 1.6 spaces for a 2-bedroom unit.

2C. A multi-story high rise residential structure consisting of the following is the final option. Two floors of retail and office use are topped by a three-story parking deck at mid height. Eight levels of residential apartments are set above this mid stack parking deck with a 14th floor amenity deck at roof top.

Parking consists of 270 spaces both self-access and tandem for 320 residential units. The corresponding ratios equal 0.8 spaces for a 1-bedroom unit, 1.2 spaces for a 2-bedroom unit and 3 spaces per 1000 sq. ft of retail and office space.

Through a series of scoring sheets, you will be asked to evaluate a variety of topics germane to our five areas of interest as both professionals and users.

We thank you for your participation and look forward to collecting your various insights.

List of questions.

Publicly built structures.

1. All structures are sized to accommodate public and private users. The first series of questions address this issue

A. Do you feel that the average ratios for residential units are adequate? 0.8 spaces for a one-bedroom unit and 1.6 spaces for a two-bedroom unit are the average ratios projected? Y / N

B. Do you agree that a mix of self-access / tandem spaces in mixed use private structures are usable? Y / N

C. Do you feel the same about this feature when incorporated into public structures? Y / N

D. Do you agree that publicly built structures should be increased in capacity to supplement private development efforts for existing property owners in the zone? Y / N

E. Do you agree that publicly built structures should be increased in capacity to supplement private development efforts for new property owners/developers in the zone? Y / N

F. Do the ratios proposed in these alternatives accommodate your family's needs and life style? Y / N

G. Do you personally expect that your need for parking will increase or decrease with age? Y / N

H. Does the fact that these development parcels occur within proximity of public transportation change your expectations in questions. F and G above? Y / N

2. The proposed height of public structures 1A and 1C is five levels and corresponds with the maximum four to five story commercial height in the zone.

A. Should the proposed height of these structure meet this existing height limit, or can they be allowed to exceed these limits if necessary? Y / N

B. A variety of overlay facades or screens are being proposed for structure 1A. Please express your preference for Y / N

(1). A traditional facade simulating a commercial exterior of a variety of materials like the illustration shown.

(2). A decorative facade consisting of screening elements and/or advertising displays like the illustration shown.

Recognize that these advertising programs can help contribute to the project income stream underwriting the public burden of financing this structure.

(3). A decorative facade consisting of screen elements with sustainable features / displays like the illustration shown.

(4). A decorative facade consisting of screen elements with graphic and decorative displays like the illustration shown.

(5). A decorative facade consisting of a thematic facade of some relevance to the community at large like the illustration shown.

(6). A decorative facade consisting of a structuralist or brutalist representation like the illustration shown.

Please rank your preference for the visual treatment of the public decks in order from best to worse using the following scale.

Treatment 1 Traditional – historic -10 .....-5.....0.....+5 .....+10

Treatment 2 Screening – with or without advertising -10 .....-5.....0.....+5 .....+10

Treatment 3 Screening - sustainable -10 .....-5.....0.....+5 .....+10

Treatment 4 Screening - decorative -10 .....-5.....0.....+5 .....+10

Treatment 5 Decorative thematic -10 .....-5.....0.....+5 .....+10

Treatment 6 Structuralist/brutalist treatment -10 .....-5.....0.....+5 .....+10

3. Option 1B is either a mechanical or traditional sub-grade garage. The benefits of this approach include preserving open space and the elimination of parking as a visual element in the downtown zone.

A. The cost of building a garage is approximately two times the cost of building a traditional above grade parking structure.

Would you support this additional expenditure as a tax payer, to accommodate parking for commuters? Y / N

B. The cost of a garage utilizing mechanical / robotic parking is approximately twice the cost of a traditional sub grade garage. And four times the cost of a traditional above ground garage. It is also true that the capacity of this garage can be increased two-fold by Incorporating a mechanical / robotic system.

Would you support this additional expenditure as a tax payer, to accommodate parking for commuters? Y / N

4. Option 1C is an above grade parking structure that includes a ground floor retail element and a recreation field at the top level.

The cost of the recreation element will increase the cost of this parking deck by approximately 20%. Would you support this additional expenditure as a tax payer, to accommodate parking in the interest of extending the use and utility of this structure? Y / N

5. All three public structures provide access for vehicles from minor streets or alleys. This is being done to preserve public parking on the street and to eliminate conflicts of multiple curb cuts with pedestrian movement.

Do you agree with this approach for purposes of preserving on street parking and for pedestrian safety? Y / N

6. The city is also considering increasing the capacity of these structures to eliminate most if not all on street parking in the zone. This is being suggested to increase walk ability in the downtown area and to create additional space for outside gatherings, public functions and to accommodate alternate mobility options including bicycling, Uber and Lyft pick up and drop offs areas, and to provide additional landscaping and street features in the zone.

Do you agree that the elimination of on street parking to accommodate these uses makes sense even if it implies an increased cost of development to provide these amenities? Y / N

7. The city is also planning to invest in a visual and phone app system to provide constant feedback and notice of available spaces in the several public structures. This inventory system should result in a downsizing of overall parking demand as the efficiency of these structures increases.

Additionally, roaming time associated with seeking and identifying available on street spaces will be dramatically reduced by the implementation of these systems. Y / N

Would you support this additional expenditure to provide this benefit as a tax payer? Y / N

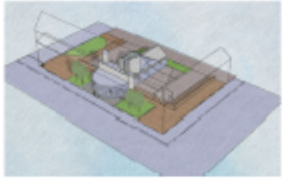
8. Of the three options being considered by the city. How would you rate each of the following utilizing the scale provided?

1A. Freestanding deck.

Sizing	-10 .....-5.....0.....+5 .....+10
Scale	-10 .....-5.....0.....+5 .....+10
Massing	-10 .....-5.....0.....+5 .....+10
Visual Representation	-10 .....-5.....0.....+5 .....+10
Placement	-10 .....-5.....0.....+5 .....+10

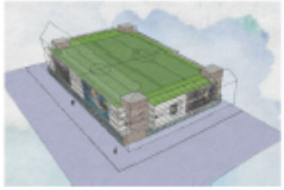
1B. Subgrade garage.

Sizing	-10 .....-5.....0.....+5 .....+10
Scale	-10 .....-5.....0.....+5 .....+10
Massing	-10 .....-5.....0.....+5 .....+10
Visual Representation	-10 .....-5.....0.....+5 .....+10
Placement	-10 .....-5.....0.....+5 .....+10



1C. Freestanding deck with ground floor retail and a recreation deck

Sizing	-10 .....-5.....0.....+5 .....+10
Scale	-10 .....-5.....0.....+5 .....+10
Massing	-10 .....-5.....0.....+5 .....+10
Visual Representation	-10 .....-5.....0.....+5 .....+10
Placement	-10 .....-5.....0.....+5 .....+10



<u>Privately built structures</u>

Three alternative models for privately developed mixed use buildings have been proposed for the zone.

The first consists of a four story wrap around residential building.

The second consists of a five-story podium type building.

The third a 15-story high rise structure.

A. Do you agree that all three models can appropriately be sited in the zone? **Y / N**

If not, which model is of concern? **Low rise** **Podium.** **High-rise.**

B. The low-rise building includes and an active ground floor along its major frontage.

Do you agree that this is important feature of this model? **Y / N**

C. The podium building provides additional areas of set back as open space along its major frontage.

Do you agree that this is important feature of this model? Y / N

D. The high-rise building includes and an active ground floor along its major and minor frontages.

Do you agree that this is an important feature of this model? Y / N

All three options respect the narrow and wide street base height requirements in the zone. The high-rise option does this by articulating the screening elements of the of mid-stack parking element along all frontages.

E. Do you agree that this is an effective means to address the massing and scale issues of this high-rise tower? Y / N

The high-rise tower violates the sky plane regulations above this point by continuing without setback to Its full height.

F. Do you take issue with this feature from a scale and massing point of view? Y / N

Private open space is incorporated into all three mixed-use options.

G. Do you object to the private nature of these open space features in the downtown zone? Y / N

H. If the answer is yes, what alternatives might you suggest addressing the open space requirements in the zone?

_____

I. Traditional stone and brick facades have been depicted for all three mixed use prototypes. Other alternatives exist and are depicted below.

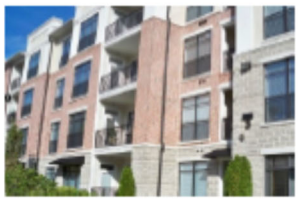
Please weigh your preferences below remembering that this is a downtown district of a variety or buildings of different ages with historic and non-historic treatments.

(1). Wood and glass facades like the illustration shown.

-10 .....-5.....0.....+5 .....+10

(2). Stone and brick facades like the illustration shown.

-10 .....-5.....0.....+5 .....+10



(3). Glass and metal facades like the illustration shown.

-10 .....-5.....0.....+5 .....+10

(4). Concrete / glass facades like the illustration shown.

-10 .....-5.....0.....+5 .....+10

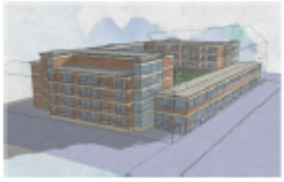
I. Like the public parking models access for vehicles is generally obtained from minor streets alleys.

Do you agree with this approach? **Y / N**

J. Of the three options being considered by the city as privately built mixed use building types how would you rate each of the following utilizing the scale provided?

2A. Wrap around residential with ground floor retail and concealed parking.

Sizing	-10 .....-5.....0.....+5 .....+10
Scale	-10 .....-5.....0.....+5 .....+10
Massing	-10 .....-5.....0.....+5 .....+10
Visual Representation	-10 .....-5.....0.....+5 .....+10
Placement	-10 .....-5.....0.....+5 .....+10



2B. Podium parking and residential mid-rise without an active retail frontage

Sizing	-10 .....-5.....0.....+5 .....+10
Scale	-10 .....-5.....0.....+5 .....+10
Massing	-10 .....-5.....0.....+5 .....+10
Visual Representation	-10 .....-5.....0.....+5 .....+10
Placement	-10 .....-5.....0.....+5 .....+10

2C. High rise residential with ground floor retail and mid stack parking.

Sizing	-10 .....-5.....0.....+5 .....+10
Scale	-10 .....-5.....0.....+5 .....+10
Massing	-10 .....-5.....0.....+5 .....+10
Visual Representation	-10 .....-5.....0.....+5 .....+10
Placement	-10 .....-5.....0.....+5 .....+10

Part 2. Focus group. Structured parking and overall redevelopment programs for three selected cases

Now that we have dug into the specifics of structured parking in a downtown context, we want to extend the discussion in a more generalized way to three cases representative the of the kinds of redevelopment programs being encountered today.

Case 1. Urban central city transit site.

Our first case consists of a 4.0-acre site located at a major destination in an urban central city context. The site is adjacent to a major and long-standing commuter rail stop, Broad Street Station, Newark, and is also co located with the terminus of a surface light rail line that spans the commercial sector of the city.

To the south and east of this site is a major university and Medical center, to the east a significant redevelopment zone slated to embrace a mix of high-rise residential and commercial towers. To the north a low-scale, low-density residential neighborhood exists, the second generation of replacement buildings in a federal urban renewal zone dating back to the post war years.

Case 2. Suburban regional transit site and office park.

The second case consists of a regional transit HUB, Metro Park Station. The site is located in Iselin/Woodbridge, NJ. The site consists of 8.5 acres and it located between the Amtrak Northeast Corridor rail road right of way and a long-standing office park consisting of suburban office buildings on independent sites ranging between 5 and 10 stories.

The site is also located adjacent to a major north/south limited access highway that unites the entire state. The Garden State Parkway connects to the district and Route 95 one exchange to the south. The area to the north is a low scale single-family neighborhood and the commercial park to the south can be considered a single-use office with some hotel uses.
Missing is a significant retail or housing element in this more than 200-acre development zone.

Case 3. Ex urban cluster located at major interstate exchange.

The final case consists of a redevelopment zone located at the interchange of two major interstates located in Parsippany, NJ. The site is a low scale single use office park consisting of multiple three-story suburban office buildings. The parcel is underutilized and consists of over 450,000 sf of empty office space.

North and east of the site and the adjacent interstate right of ways lies a typical highway scale commercial district along with scattered office buildings attaining an overall five to six story height. To the south and immediately bordering this 48-acre site lies a low-scale neighborhood of single-family homes on small eighth of an acre sites.

This site is representative of redevelopment occurring in peripheral areas and represents the recasting of former and defunct office parks, retail malls and research parks throughout the region.

Test cases. Alternate approaches to redevelopment of these generically different and distinct development scenarios.

Two to three redevelopment scenarios have been created for each of the three zones in question. You will be asked to view videos and graphic depictions of the several alternates and to provide your general and overall impressions of each. Please react to each alternative based on our identified five areas of interest depicted in our earlier sessions. Those five areas of inquiry again consist of Sizing, scale, massing, aesthetics / visual representation and placement.

While each case is different in terms of context the alternatives provided represent consistent and alternate takes on density, height, yield and parking deployment. They utilize two or more of the redevelopment prototypes developed for the first part of this focus group to arrive at these alternate redevelopment scenarios.

After viewing the video and graphic presentation for each scenario please score each alternative across our twenty-point scale.

Case 1. Central city urban redevelopment site

Case 1 A. Low scale wrap around alternative representing a density approximately 60 units per acre

Case 1 B. Large-scale high-rise alternative representing a density of 120 units per acre.

In each scenario either a freestanding public parking deck or a subgrade garage is sited to address the demands for public and commuter parking.

Case 2. Regional transit suburban redevelopment site

Case 2 A. Low scale wrap around alternative representing a density approximately 60 units per acre

Case 2 B. Medium-scale mid-rise podium alternative representing a density of 90 units per acre.

Case 2 C. Large-scale high-rise alternative representing a density of 120 units per acre.

In each scenario either a freestanding public parking deck or a subgrade garage is sited to address the demands for public and commuter parking.

Case 3. Ex. urban cluster redevelopment site

Case 3 A. Low scale wrap around alternative representing a density approximately 60 units per acre

Case 3 B. Large-scale low, medium and high-rise alternative representing a density of 90 units per acre.

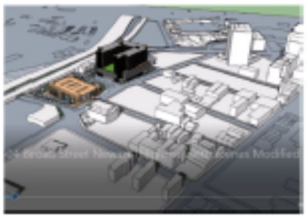
In each scenario either a freestanding public parking deck or sub garage is sited to address the demands for public and commuter parking.

Please now score each alternative using the following charts.

Case 1A. Low rise.

Sizing	-10 .....-5.....0.....+5 .....+10
Scale	-10 .....-5.....0.....+5 10
Massing	-10 .....-5.....0.....+5 .....+10
Visual Representation	-10 .....-5.....0.....+5 .....+10
Placement	-10 .....-5.....0.....+5 .....+10

Case 1B High rise.



Sizing	-10 .....-5.....0.....+5 .....+10
Scale	-10 .....-5.....0.....+5 .....+10
Massing	-10 .....-5.....0.....+5 .....+10
Visual Representation	-10 .....-5.....0.....+5 .....+10
Placement	-10 .....-5.....0.....+5 .....+10

Please record other impressions important to each alternative.

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_____

Case 2A. Low rise.

Sizing	-10 .....-5.....0.....+5 .....+10
Scale	-10 .....-5.....0.....+5 .....+10
Massing	-10 .....-5.....0.....+5 .....+10
Visual Representation	-10 .....-5.....0.....+5 .....+10
Placement	-10 .....-5.....0.....+5 .....+10

Case 2C. High rise.

Sizing	-10 .....-5.....0.....+5 .....+10
Scale	-10 .....-5.....0.....+5 .....+10
Massing	-10 .....-5.....0.....+5 .....+10
Visual Representation	-10 .....-5.....0.....+5 .....+10
Placement	-10 .....-5.....0.....+5 .....+10

Case 2C. High rise.

Sizing	-10 .....-5.....0.....+5 .....+10
Scale	-10 .....-5.....0.....+5 .....+10
Massing	-10 .....-5.....0.....+5 .....+10
Visual Representation	-10 .....-5.....0.....+5 .....+10
Placement	-10 .....-5.....0.....+5 .....+10

Please record other impressions important to each alternative.

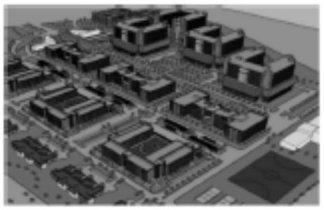
_____

_____

Case 3A. Low rise.

Sizing	-10 .....-5.....0.....+5 .....+10
Scale	-10 .....-5.....0.....+5 .....+10
Massing	-10 .....-5.....0.....+5 .....+10
Visual Representation	-10 .....-5.....0.....+5 .....+10
Placement	-10 .....-5.....0.....+5 .....+10

Case 3B. High rise mix



Sizing	-10 .....-5.....0.....+5 .....+10
Scale	-10 .....-5.....0.....+5 .....+10
Massing	-10 .....-5.....0.....+5 .....+10
Visual Representation	-10 .....-5.....0.....+5 .....+10
Placement	-10 .....-5.....0.....+5 .....+10

Please record other impressions important to each alternative.

_____

_____

Part 3. Focus group. Structured parking and overall redevelopment programs in transition

Exhibit X generally describes the general trends in transition that are reshaping our understanding demands of and demands for personal vehicles and their parking accommodations

The three principal areas of concern and interest consists of demographic and lifestyle changes in the Millennial and Generation X, Y and Z cohorts, changes in mobility including autonomous vehicles and ride share alternatives and finally changes in development and settlement patterns that emphasize urban living in both central city, suburban downtowns and exurban areas like those studied in our case examples.

A brief overarching discussion is planned to record your impressions in all three areas of interest and as it impacts them potential downsizing of parking demand, the readapting of these structures and alternate uses and other outcomes falling out of these trends.

A series of related questions are as follows.

K. Do you believe the downsizing of demand for private vehicles will continue with a related reduction in a reduced need for parking accommodations? Y / N

2 Do you believe that ride share, and autonomous jitney will replace the need for private vehicles? Y / N

3. Do you believe that work from home and other co work environments will replace the need for commutation to workplaces in our future? Y / N

4. If all these trends in fact occur do you foresee the significant elimination of parking lots a parking structures in the future? Y / N

5. What kinds of uses would you like to see these former parking lots and parking structures adopt?

_____

7. Personally, can you foresee a time when you:

A Relocate to an urbanized community of the scale depicted in these studies? Y / N

B Reduce your auto dependency to a single vehicle or less per family ? Y / N

C Increase your use of public transportation including Uber/Lyft and other potential ride where a private vehicle will no longer be required? Y / N

8. Are there any other impressions you would like to record in this subject area?

_____

Part. 4. Focus Group Evaluation.

Several impressions of this session will help us in our future research efforts on this subject.

1. Was the intent of this focus group well communicated? Y / N

   And if not, what might be done to improve this presentation?

   _____

   _____

2. Where the exhibits and videos clear and understandable? Y / N
3. Where the questions being posed clear and on point? Y / N
4. If the abstract nature of some of these areas of inquiry were difficult to conceptualize, what can be done to more clearly articulate those areas of interest?

   _____

   _____

5. What other impressions of this session would you like to communicate?

   _____

   _____

   _____

Thank you for your participation. Your efforts on behalf of this research effort are most appreciated.

Personal information for profiling purposes: **This information is confidential and will not be shared**

Optional:

Marital status Married/Single./Divorced/Other M_____ S_____ D_____ Other_____

Your age No. of children at home/ages _____ _____

Please provide:

Education level reached _____

Areas of expertise _____

Elected or appointed positions filled _____

Housing choices:

You are living now in a: _____ Single family _____ Townhouse

_____ Apt. suburban _____ Apt. downtown

_____ Apt. or Single family home resort location

Your choice as you age will be: _____ Single family _____ Townhouse

_____ Apt. suburban _____ Apt. downtown

_____ Apt. or Single family home resort location

Note. Apt. = an apartment in a multi-family building or complex

Number of private vehicles in family : _____

Do you commute to work at least 3 days a week Y / N _____ _____ _____ _____
Car Transit Ride share Walk/other

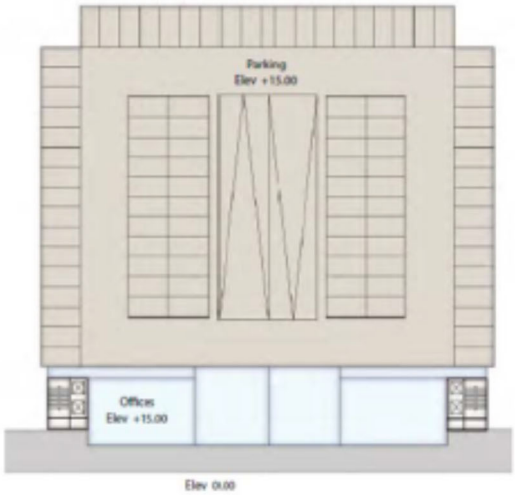
Currently work from home at least part of the week Y / N

APPENDIX J

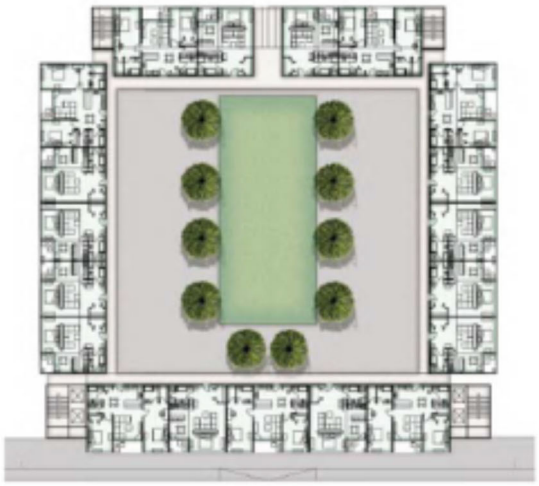
VPS Session Protocols

J – 6 Parking deck conversion exhibits

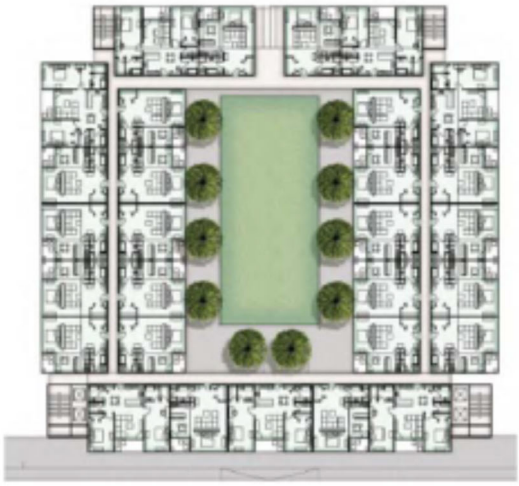
First Floor



Second Floor



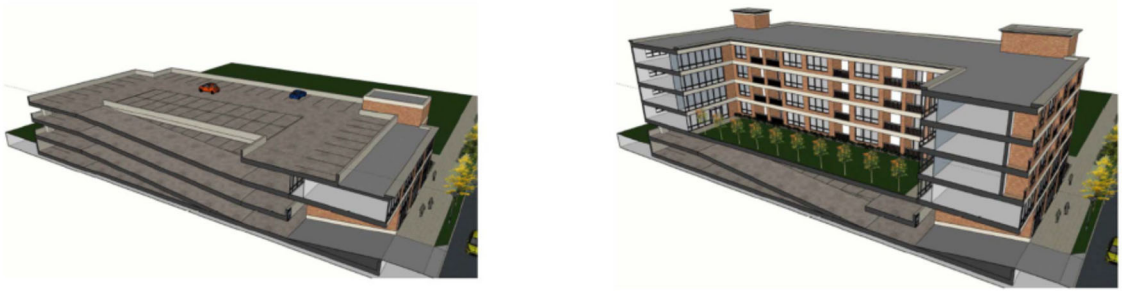
Floors 4-6 (Initial Phase)



Floors 4- 6 (Final Phase)

The potential adaptation of a freestanding deck with office and retail frontage.

Renovation of in place floors to residential units , and the addition of modular housing units at the upper stories.



The potential adaptation of a freestanding deck with office and retail frontage

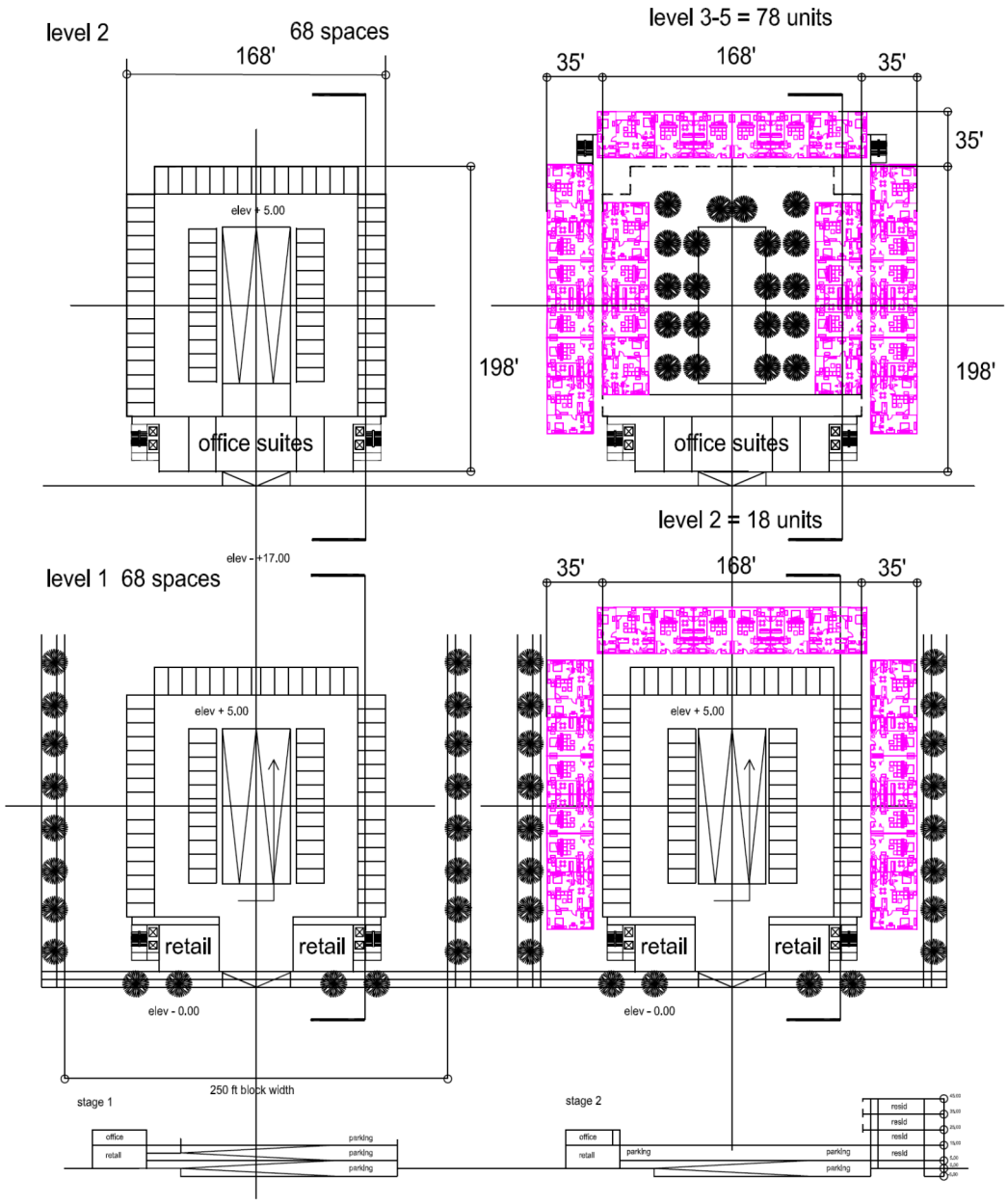
Transition from a single use structure to mixed use residential over a progressive stages of conversion

OPTION A - NARROW DECK ALL SELF PARK

Freestanding parking deck converted to wrap around residental building Sept 2018

168x198 = 33,265 gsf - parking/retail 243x233 = 56,620 gsf w/residential

96 UNITS AND 136 SPACES = 1.42/UNIT PLUS RETAIL/OFFICE COMPONENT

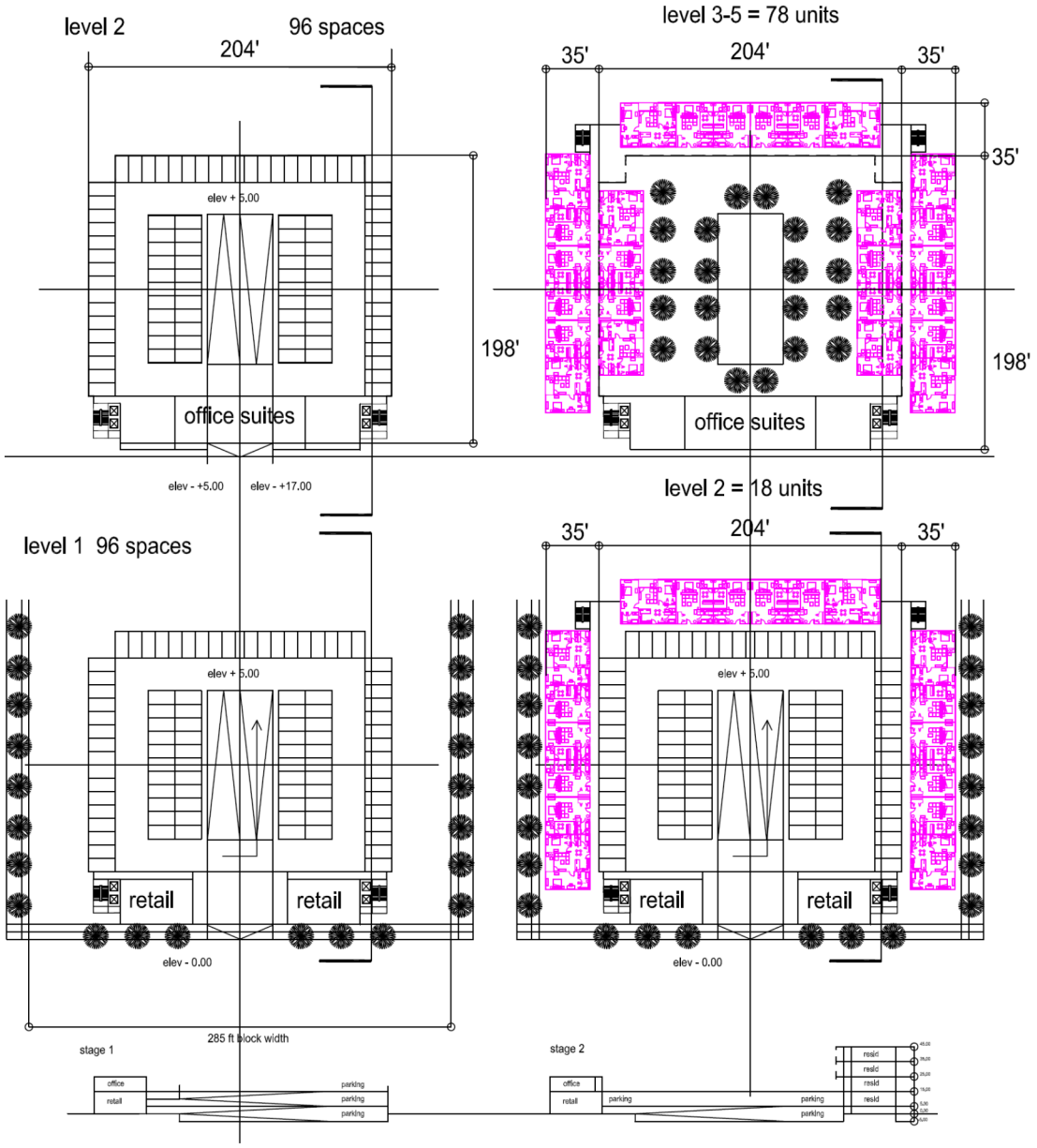


OPTION B - WIDE DECK SELF PARK AND TANDEM SPACES INCLUDED

Freestanding parking deck converted to wrap around residental building Sept 2018

204x198 = 40,392 gsf - parking/retail 279x233 = 65,007 gsf w/residential

96 UNITS AND 192 SPACES = 2.00/UNIT PLUS RETAIL/OFFICE COMPONENT



APPENDIX J

VPS Session Protocols

J -7 Trends

What are the currents that will transform structured parking in the coming decades? A number of trends are actively impacting the issue as we speak. Some are open-ended, their outcomes over the next decades both difficult to discern and quantify.

The four principal areas of our concern are:

- Engineering and technology
- Demographics
- Mobility
- Settlement

Engineering and technology.

The effort to mechanize parking grown out of a need to create more and denser packing of vehicles in more and more confined spaces.

One of the first mechanized or automated parking decks was built in Hoboken in the early 2000s. This five-story structure is capable of tacking 314 vehicles in a footprint of 10,000 SF. The capacity of this structure represents a two-fold increase over a standard self-parking deck with a traditional ramped configuration.

The structure consists of a system of trays and elevators that permits the loading of cars from ground level to steel storage cells, allowing for the stacking of vehicles and their subsequent retrieval.

The shortfalls:

- Construction complexity that makes roll-out difficult.
- A cost of delivery close to twice the per-space cost of standard parking structures.
- Mechanical breakdowns that inhibit access.
- Retrieval times that can run too long, giving mechanized parking a reputation as being solution better for long-term rather than short-term parking.

The future prospects for mechanical parking represent a narrow slice of the market; innovations in its applications, while important, are not substantive in a wider sense for structured parking overall.

Also, and importantly: the innovation represented by mechanical systems is premised on an increasing demand to build more and denser accommodations for structured parking at costs that lie outside customary parameters. This premise, as we will see below, is being challenged. A reappraisal of demand, more than any other factor, may ultimately roll back this demand for more parking at extremes of cost and practical utility. Mechanized parking for the most dense

and costly urban settings will persist, but on an isolated basis.

Demographics.

Changing ownership and travel patterns of Millennials points towards a downsizing of demand for personal vehicles. Roughly equivalent in number to baby boomers, Millennials are in fact the boomers' progeny. The impacts of their lifestyle choices are proving to be just as wide-ranging and significant as that of their parents.

Delaying driver license applications, the growth in popularity of service apps such as Lyft and Uber, along with a renewed usage of jitney and transit, all point towards a future downsized demand. This reduced demand could translate into a decreased need for structured parking both long and short term.

Whether these indicators will translate as this generation ages into long-term reductions in demand remains to be seen. The impact is not readily quantifiable. But it remains that a change in deployment of personal vehicles by Millennials is having a real and discernible impact on parking, even in these early stages.

Mobility.

The automobile industry is searching for a new era of innovation, with innovation-for-innovation's-sake shaping some of the newest technologies now seriously pursued at the R&D level. Autonomous vehicles and their deployment for both fleet, taxi and personal use represents one of these areas of innovation.

Millions of dollars are being invested in this area of interest, referred to as the "digital transformation" of the automobile industry. Electronics, computer learning apps, and scores of other digital innovations are being synthesized in these efforts to roll out a truly practical and safe independent personal vehicle.

Multiple stages of autonomous automation have been institutionalized. These range from driver-assist functions to fully autonomous functionality. However, the later stages of development are in fact proving to be decades off in terms of practical application.

Despite these limitations and the certainty of an ultimate roll-out, the prospects for autonomous vehicles result in three possible scenarios:

- It is anticipated that ultimately the driving public will abandon personal vehicles and opt for the deployment of a fleet-based retrievable systems, freeing themselves from the burden of personal ownership and the expense of ongoing maintenance.

- It is assumed that with this transition, a decrease in demand for parking will position urban builders not only to abandon new construction but will position them to eliminate scores of obsolete parking structures, making them available for new and converted uses.

- The projections for demand reduction are also undercut by the presumption that these innovations will give seniors, the handicapped (including the visually impaired) and others increased (and unprecedented) access to personal transportation.

Like other radical innovative strategies promoted as the panacea for future ills, the final outcomes will likely fall somewhere in the middle.

But can and should we anticipate that this promised revolution in personal transport will decrease demand for parking sufficiently to necessitate and enable conversion of parking to other uses? The answer to that question is a qualified "yes."

Likewise, should we work towards planning and design accommodations that anticipate longer and denser queuing lines for autonomous and ride share vehicles? The answer to that question is a more definite "yes." Rideshare alone is already altering access issues at major points of departure and arrival, such as airports, terminals and the like.

Two overriding, questions, however remain. At what level of investment should we practically engage in accommodations to these future and uncertain realities? And what ultimately will these potential accommodations look and feel like for practical reinventions of parking as a building form, and as an element in the street scape?

Settlement

Public policy and Smart Growth strategies, as we have seen, are creating significant impacts on the American landscape. Redevelopment of urban zones and peripheral development areas are focused first and foremost in areas with transit linkages.

The Regional Plan Association's Fourth Regional Plan for the NY/NJ/CT area, published in summer 2018, calls specifically for clustered development focused at railheads and other regional clusters where transit, interstate, and other access infrastructure coincides. In fact, the RPA sees ride-share — and not hard rail extensions — as the means to extend transit access beyond these termination points.

The changing patterns of development focused on urbanized environments speak to a lessening of personal transit as the first choice for mobility and access. When planning these new development clusters, the issues of decreased demand for parking is also coupled with other patterns of use being integrated into these mixed-use complexes.

Mixed-use developments, the planned walkable communities that include co-working/co-living environments coupled with basic amenities such as shopping, entertainment and eating venues, can significantly reduce demand for personal transportation. The development of several thousand units with such features can create an urban village in which off-site travel is a rarity.

The reinventing of suburban downtowns and the redeployment of aging single-use regional office parks and retail malls is occurring in every major real estate market in the country and is no longer an anomaly on planning board and board of adjustment agendas.

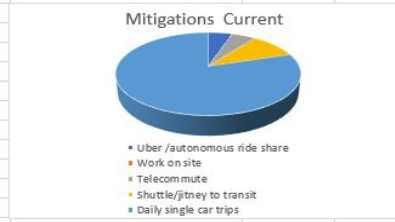
Summary

Each of these four areas of impact will ultimately shape our understanding of the demand for parking in its next generation of development.

The accompanying table depicts one potential scenario being offered in-conjunction with public testimony for a significant scaled redevelopment currently underway. The diagram traces potential shifting of transit and transportation patterns over a twenty-year cycle, the average lifespan of a new development of this type. It projects an overall reduction in personal vehicle trips at the onset from 80% of 50% over that time span.

For a development of approximately 2200 residential units utilizing a parking ratio of 1.8 per unit (or 4,000 spaces), this represents a significant reduction in parking demand: a 37.5% differential equal to 1,500 spaces. This represents a savings in infrastructure costs of some $33 million, a not-insignificant sum.

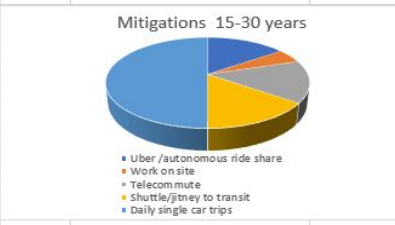
Mitigations per 100 single trips	Current
Uber /autonomous ride share	5
Work on site	0
Telecommute	5
Shuttle/jitney to transit	10
Daily single car trips	80



Mitigations per 100 single trips	5-10 years
Uber /autonomous ride share	10
Work on site	5
Telecommute	5
Shuttle/jitney to transit	15
Daily single car trips	65

Mitigations per 100 single trips	10-15 years
Uber /autonomous ride share	10
Work on site	5
Telecommute	10
Shuttle/jitney to transit	15
Daily single car trips	60

Mitigations per 100 single trips	15-30 years
Uber /autonomous ride share	15
Work on site	5
Telecommute	15
Shuttle/jitney to transit	15
Daily single car trips	50



Will all of these factors play out as depicted? That remains to be seen. However, it is clear that each will have some impact on the future definition of structured parking.

A recent study conducted by the Mortgage Banking Association in five major and representative urban real estate markets makes it clear that the nation is seriously over-parked, to use a phrase coined by Donald Shoup in his seminal work The High Cost of Free Parking.

This recognition by a leading association in the world of finance and investment in commercial and residential lending is no small event. It perhaps indicates a changing and shifting perspective, along with a new understanding at the institutional level that it is time to recognize the need for a redefinition of parking — and structured parking in particular — as a centerpiece of development efforts nationwide.