Written Deputation- CITY OF MELVILLE CAR PARKING STRATEGY(2014)

Submitted By: Max FitzGibbon

Date prepared: 6 April 2020

Mayor Gear, Councillors, and Officers,

I am passionate about Road Safety in the City of Melville, and elswhere, and as a resident of Melville for 26 years, have become concerned about what I consider to be a degrading of the prevailing safety of our roads in CoM, predominately attributable to the increasing provision of on-street embayed car parking in verges adjoining mixed use and residential apartment developments.

All of my working career, including as a military engineer, I have been directly responsible, as a line manager, for the safe working practices, and safety, of hundreds of workers, taking a hands on approach and setting an example for my team leaders to follow. Safety performance was a feature of performance appraisals, and it was item number one on the agenda of the managing director's monthly meeting, as it should be. In any business there is no higher priority than the safety of its people and its stakeholders.

When I arrived in Melville in late 1993, from Brisbane, I was taken by the wide verges and extensive sight lines attributable to the relative absence of on-street car parking. Residents keep it this way. This stuck me as being streets ahead of what I had observed in Brisbane, Melbourne and Sydney, from a road safety perspective.

Then, in 2016, I noticed on-street car parking being proposed on street at 94 Kitchener Road, Alfred Cove. I objected to the DA proposal, on road safety grounds due to the introduction of on-street parking bays with consequent reduced sight lines and the possible conflict with pedestrians and cyclists, particularly children.

A DA with 42 car bays in the verge at McGregor Road, Palmyra, followed. 40 of these bays are 90 degree angle parking. This format is considered by Austroads to be the most dangerous parking configuration. It is also a smorgasboard for car theft.

Next was 57 Carrington Street, Palmyra. Here I had one bay removed at JDAP, as a submitter, because it blocked sightlines. Parking cars have to cross an in verge cycle lane to park two cars and two motor cycles. Such manoeuvres are highly dangerous. This is on a 60kph road for which Austroads considers on-street car parking usually be prohibited.

Each of the above cases of on-street parking were facilitated at JDAP via CoM Car Parking Strategy (2014), Clause 2.2, On-street versus Off-street Car Parking. A search, by me in 2017, of the terminology used revealed clause 2.2 was from physical research conducted by Marshall et al in the USA, in 2008. This Marshall research(pages 45 -52) subsequently became an Austroads reference in its Guide to Traffic Management, Part11: Parking. page 17, Benefits and Costs, under the banner of "Shared parking" This Austroads reference advises that the research applies to Town and Activity Centres, terminology actually used in clause 2.2, and it concluded that on-street parking is "a tool to help create places that are safer, more walkable, require less parking, and have more vitality."(in Activity and Town Centres.) The research makes clear that the effective use of on-street parking in Activity and Town Centres depends upon a whole package of conditions being present, including if less than 30 percent of bays were occupied, traffic speed was not reduced. The research applies to a shopping strip similar to Rokeby Road, Subiaco, or Oxford Street, Leederville. The research further advises "In fact, on-street parking without other supportive conditions may be counter productive and result in extremely unsafe conditions." In CoM, it has been used in areas other than Activity and Town Centres to which it applies. Clause 2.2 needs amendment to clarify its application consistent with Austroads Guide to Traffic Management, Part11: Parking, in Town and Activity Centres.

Currently, we have Jackson Avenue, Winthrop, under consideration for five on-street bays in the verge, and again reverse parallel parking cars will have to cross an "existing" cycle lane on the road shoulder to get into and out of bays too deep in the verge. This puts cyclists at risk of side-swiping and car-dooring, something that they do not currently have to contend with. This is totally avoidable because the development has prior LDP approval to use five shopping centre bays for visitor parking. This development has 22 excess on-site bays in the undercroft available for sale by the developer, or alternatively, for use as visitor bays.

I fully support the motion of Cr Sandford to amend clause 2.2 of the Car Parking Strategy(2014), to ensure its use is as intended, for Activity and Town Centres.

Thank you, and stay safe.

Max FitzGibbon

Att: PDF 43 Marshall research introduction page.

PDF 44 Research conclusion page.

PDF 7-1 Full 8 page Marshall research paper.

Reassessing On-Street Parking

Wesley E. Marshall, Norman W. Garrick, and Gilbert Hansen

The ongoing debate about the merits and drawbacks of on-street parking offers few definitive answers because comprehensive research in this area has been lacking. The goal is to develop a better understanding of the gamut of issues related to on-street parking, ranging from parking demand and the pedestrian environment to less researched topics such as the efficiency of land use. In addition, the basic question of safety is addressed in a more precise way than previously by taking into account actual vehicle speeds and crash severity levels. The investigation points to on-street parking as crucial in benefiting activity centers on numerous levels. Users of the downtowns consistently valued these land-efficient on-street parking spaces over and above off-street surface lots and garages. Low-speed streets with on-street parking also had the lowest fatal and severe crash rates of any road category in the study of 250 Connecticut roadway segments. Part of the reason is that the presence of parking had a measurable effect on vehicle speeds. On-street parking is not purely a device to be used in the right environment; rather, it is a tool to help create that right environment. On-street parking should be more commonly used but especially in situations in which the road is part of the destination and the intent is to cause drivers to slow down. Results suggest that these places are safer, are more walkable, require less parking, and have more vitality.

The ongoing debate about the merits and drawbacks of on-street parking offers few definitive answers because research on this subject has been lacking during the past two or three decades. Some downtowns simply provide on-street parking wherever possible, whereas others prohibit it as being unsafe and a nuisance to moving traffic. Part of the problem is that prevailing thought on the subject has shifted over the years. Consequently, finding real answers is difficult because even the best studies appear to focus on one or two qualities of on-street parking, failing to account for the broad range of potential outcomes.

Even though many planners, engineers, and particularly New Urbanists now consider on-street parking an integral part of any downtown, questions linger. Proponents cite places in which on-street parking works incredibly well, whereas detractors cite places with contrary results. One issue is that these examples are informal and rarely based on more than word of mouth concerning the true outcomes. The bigger issue begs the question as to why some places have been successful when it comes to incorporating on-street parking in their downtowns. With this research, the intent is to develop a better understanding of the gamut of issues related to on-street parking, ranging from parking demand and the pedestrian environment to less researched topics such as land use and the impact on vehicle speed. In addition, the basic question of safety is addressed in a more precise way than previously done with on-street parking studies by taking into account vehicle speeds and crash severity.

The findings in this paper are an outcome of two separate studies. These questions were assessed in a first study by developing case studies for six major commercial activity centers in small New England cities and towns and in a second study by investigating vehicle speeds and safety reports from more than 250 Connecticut roads. The case study sites were selected to be either traditional town centers with dense, walkable mixed-use downtowns with on-street parking or contemporary sites with more conventional single-use zoning and little or no on-street parking. Brattleboro, Vermont; Northampton, Massachusetts; and West Hartford, Connecticut, represent the older more traditional downtowns. The second group of more contemporary sites includes Avon, Connecticut, and Somerset Square in Glastonbury, Connecticut, two newer commercial centers, along with Glastonbury Center, Connecticut, which was a traditional downtown that has been expanded along more conventional lines.

The speed and safety study was based on collecting more than 100 free-flowing vehicle speeds for each site in addition to safety information and road segment characteristics. Streets were purposefully selected with and without on-street parking and with different speed limits and adjacent land uses so that the 250 sites represented a wide array of road characteristics.

By relying on multiple lines of research, the intent is to forge a more complete analysis of on-street parking. An assessment will be made of the benefits and shortcomings of on-street parking vis-à-vis the other common methods of supplying parking (off-street surface parking and structured garage parking), and the context in which on-street parking can be successfully employed will be considered.

LITERATURE REVIEW

On-street parking has a varied and inconsistent history. Once prevalent almost everywhere in the United States, restrictions against on-street parking began as early as 1920 (*1*). When the rapid rise of the automobile in downtown Los Angeles, California, started to impinge on the flow of streetcars, the quick and easy solution was to ban on-street parking. A mere 19 days later the ordinance was repealed for a variety of reasons, including claims that the parking restrictions were discriminatory against motorists. Seven years later, Chicago, Illinois, instituted some of the earlier successful on-street parking restrictions (*1*). The difference in this case was that Chicago continued to allow priced on-street parking in some areas. Los Angeles on the other hand flip-flopped back and forth on the issue for decades. What Chicago appeared to find was that on-street parking not only provided revenue, but was also convenient and buffered pedestrians from the moving traffic. Although it is difficult to argue with the convenience factor

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TABLE 3 Crash Rates for Street Types

	Actual Speed	No. of Sites	Total Miles	Crash Rate/Mile/Site (1998–2003) Fatal	Severe	Minor	PDO[a]	All
Parking	Low speed (<35 mph)	13	3.06	0 (0%)	11.1 (3.8%)	47.7 (16.5%)	231.1 (79.7%)	289.9 (100%)
	High speed (35–40 mph)	5	1.45	0.7 (0.2%)	29.0 (8.5%)	89.7 (26.2%)	222.8 (65.1%)	342.1 (100%)
No parking	Low speed (<35 mph)	13	2.36	0 (0%)	28.0 (10.4%)	48.3 (18.0%)	192.0 (71.6%)	268.2 (100%)
	High speed (35–40 mph)	24	5.12	0.2 (0.1%)	17.2 (9.7%)	44.7 (25.3%)	114.8 (64.9%)	177.0 (100%)

[a]PDO = property damage only.

lowest rate per mile of fatal and severe crashes but not the lowest rate for all types of crashes. In other words, more than 96% of crashes that occurred on low-speed streets with parking resulted in either a minor injury crash or a property damage only crash; only 4% of the crashes on these low-speed streets resulted in severe injuries. On low-speed streets without parking, 10% of the crashes resulted in fatal or severe injuries. It is equally important to note that high-speed streets with parking generally had higher crash rates at all severity levels than all other street categories (only five street segments in this study fell into that category). However, this large discrepancy in safety outcomes between low-speed and high-speed streets with parking might be one of the reasons that these results differ from previous research in which no distinction was made on the basis of roadway speed.

These results point to the importance of considering context in assessing the potential for on-street parking, because a low-speed environment for on-street parking appears to be critical in ensuring safe use. Current thinking in street design supports this distinction. For example, the new ITE/Congress for the New Urbanism manual also recommends speeds of less than 35 mph for streets with on-street parking (*18*). In Europe, speeds on urban streets are often kept at less than 20 mph (*19*). The present results suggest that under these low-speed conditions, on-street parking helps improve safety, and in particular, these roads with on-street parking show a significantly reduced crash rate for the most severe types of crashes.

Results show that streets can be actively designed to limit speed. The provision of on-street parking is one factor that helps to reduce speeds, but on-street parking by itself is not enough. In fact, on-street parking without the other supportive conditions may be counterproductive and result in extremely unsafe conditions. This suggests that for the best results in regard to creating safe low-speed conditions, on-street parking should be part of a package that includes a street-type design (i.e., raised curbs, small building setbacks, sidewalks, vegetated buffer strips, and no shoulders).

CONCLUSION

This investigation points to on-street parking as playing a crucial role in benefiting activity centers on numerous levels. Users of the downtowns consistently selected on-street parking spaces over and above less expensive off-street surface lots and garage parking. These shared on-street spaces served a wide variety of uses while experiencing the most use and the most turnover. On-street parking also resulted in a more efficient use of land. Using the curbside for parking saves considerable amounts of land from life as an off-street surface parking lot; with land being a limited resource, this issue is particularly important in areas in which density and high activity are desired. Therefore, the benefit of being able to conserve more than 2 acres of land in small to medium town centers by providing parking on the street rather than with an off-street surface lot is immense. This efficiency in land use can allow for a much higher density commercial development than is possible if the center is to rely solely on off-street surface lots to meet all its parking needs.

On the basis of the observed variation in activity patterns in the centers studied, on-street parking offers pedestrians a safer and more comfortable environment. The strip of parked vehicles along the curbside serves as a buffer to pedestrian activities immediately beyond the curbside. Study results show that centers with on-street parking and other compatible characteristics, such as mixed land use and higher density, recorded more than six times the number of pedestrians walking around compared with the more contemporary sites, which in general lacked these traits. All other things being equal, higher-density developments with fewer large, half-empty off-street surface lots to traverse are intrinsically more walkable. These types of advantages are factors in creating vibrant places in which more people walk and bike to, and within, the town centers.

Results suggest that on-street parking can also help to create a safer environment. Although this statement seems to contradict some existing research, the reality is that lower-speed roads (less than 35 mph) with on-street parking have far fewer severe and fatal crashes. In fact, lower-speed streets without parking had a severe and fatal crash rate more than two times higher than the streets with parking. It was also shown conclusively that drivers tended to travel slower in the presence of features such as on-street parking and small building setbacks. Slower vehicle speeds provide pedestrians, cyclists, and drivers with more time to react, and when a crash does occur, the chance of its being life-threatening is greatly reduced.

Considering the current trend toward harmonizing the conflicting demands of transportation facilities, the results of this study could inform efforts in creating pedestrian-friendly streetscapes that support vibrant centers. On-street parking is not purely a device to be used in the right environment; rather, it is also a tool to help create that right environment. On-street parking should be used more commonly but especially in situations in which the street is part of the destination and the intent is to cause drivers to slow down and recognize that they have reached a place. Results show that these places with on-street parking tend to be safer and more walkable, require less parking, and have much more vitality.

2008 CHARLEY V. WOOTAN AWARD: Outstanding Paper in Policy and Organization

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and the idea of a pedestrian buffer, the debate continues as to the real benefits of on-street parking versus other types of parking in regard to issues such as land use, user demand, vehicle speeds, and safety concerns. This literature review examines the evolution of the approach to on-street parking in the United States as well as the existing research on its implications.

Even though places such as Los Angeles initiated on-street parking bans in the early part of the 20th century, the concept did not start becoming commonplace until the mid-1960s and early 1970s. By 1971, a comprehensive guide to the principles of parking by the Highway Research Board commenced its description of on-street parking by saying:

> Curb parking can seriously impede traffic movement along major routes. It typically contributes to or is directly involved with some 20 percent of urban street accidents. One of the best and most economical methods of increasing capacity and safety is the removal of curb parking. (*2*)

This line of thinking took hold during this period when vehicle movement was the main focus of authorities charged with maintaining roads. By the time this 1971 book by the Highway Research Board was written, there was already abundant support from a variety of organizations for policies that advanced the ideas it contained. A 1955 policy statement from the U.S. Chamber of Commerce called for giving the first priority of any street to the "movement of people and goods with such restrictions on curb usage as this principle may dictate" (*2*). An influential 1959 report by the National Parking Association highlighted this issue further by suggesting the eventual banning of on-street parking in downtown areas based on this idea that priority in the street realm should first and foremost be for through traffic (*2*). A 1965 study deduced not only that limiting on-street parking increases road capacity, but also that off-street parking in city centers enhances retail activity (*3*). On that basis, the authors concluded that on-street parking should be reduced wherever possible and that off-street parking will be vital in determining the economic prospects of activity centers.

All these opinions against on-street parking started to force the cities' hand. People seemed to believe that providing off-street parking, even in the form of structured garages, was less costly than supporting the economic losses due to traffic congestion, crashes, and maintaining parking meters. Even cities that are today well-known for their on-street parking listened. A 1970 San Francisco policy eliminated on-street parking in its downtown on weekdays from 7 a.m. to 6 p.m. on one side of most streets. Although the other side of the street could have been still used for parking, the city set it aside as a truck loading zone (*2*). According to the Highway Research Board at the time, on-street parking would be acceptable only in situations in which the street is not required to function as part of the street network, the through movement of traffic can be prohibited, and the need for parking is so great that it trumps vehicular movements (*2*). This list of warrants in essence promoted the idea that first and foremost streets are for the through movement of traffic. This widespread approach to allocating the street realm away from parking toward increased vehicular movement has been a significant factor toward the current state of affairs in many American cities.

Today, there is much more thought toward accommodating multiple types of road users as well as shifting the balance toward nonmotorized modes in many urban situations. Carmel, California, has gone to the other extreme by banning off-street parking in the downtown (*1*). Many cities however have been and are still being influenced by the long-standing idea that the focus in street allocation should be on automobile movement. The research history on the effects of on-street parking is not extensive, but there have been some studies that describe certain components of the potentially multifaceted outcomes.

Theories about the benefits of on-street parking are as plentiful as the theories against. Aside from the convenience, on-street parking is said to be one of the best ways to provide shared parking (*4*). It is thought to be in higher demand than alternative off-street spaces and considered more efficient as a result of higher occupancy rates. For that reason, pricing proponents such as Shoup suggest setting the highest fees for the on-street spaces (*5*). During one of Los Angeles' on-street parking bans, the city started to find a noticeable decline in retail business (*6*). Without the on-street parking spaces, the convenience factor appeared to diminish and people shopped elsewhere.

On-street parking is also considered to be more efficient in regard to land use because on-street spaces do not require access lanes or driveways (*4*). Comparing the amount of land required for an off-street surface lot to that needed for an on-street parking space, Litman and Shoup both estimate that these access lanes and driveways more than double the amount of land devoted to parking (*1, 4*). In addition, landscaping requirements generally account for adding another 10% to 15% of total land area to a parking lot (*4*). Providing parking solutions on the street is generally less expensive. When compared with off-street surface lots, the financial savings are achieved with land use efficiency (*4*). Versus parking garages, the expense of the structure needs to be considered carefully compared with the cumulative land costs; in many instances, providing additional on-street parking rather than structured parking allows for a more prudent use of resources (*1*). On-street parking is also widely considered to have a significant effect on the pedestrian environment. Four of the most prominent pedestrian level-of-service methodologies all give better scores to streets with a higher degree of on-street parking (*7*). The buffer between pedestrians and through traffic imparted by on-street parking increases segment level-of-service scores, but these numbers do not begin to take into account the potentially increased walkability afforded to a denser place that devotes less land to parking.

In regard to the issue of on-street parking and safety, much of the research work was carried out from the 1940s to early 1970s. Almost nothing has been published since the 1980s. It would appear that to most traffic engineers the safety issues relating to on-street parking have already been decisively researched. The general conclusions drawn from these studies are that on-street parking is unsafe, prone to crashes, and subject to increased congestion. In light of the fact that a major focus of traffic engineers at the time was to speed up and discharge traffic quickly, concerned engineers were worried that on-street parking reduced road capacity, sometimes by as much as 45% (*6*). In addition, crash data from 1965 and 1966 revealed that 16% of crashes in American cities directly involved cars parking along the road (*2*).

Many studies on curbside parking prohibitions have generally suggested a decrease in traffic collisions with the removal of parking. One study found that nonintersection crash rates reduced by an average 37% for six road segments after on-street parking had been eliminated in a before-and-after study of curbside parking prohibition on arterial streets in the city of Hamilton, Ontario (*8*).

However, there have also been some contrary results. For example, an extensive Copenhagen, Denmark, study on the provision of bicycle lanes found an increase in crashes and injuries as a result of the prohibition of on-street parking to make way for bicycle lanes (*9*). The study indicated that the prohibition of curbside parking shifted parking onto side streets, which increased turning traffic. The issue of providing, maintaining, or prohibiting curbside parking should be considered not only in regard to total crashes but also in the context of the land use and traffic priority of the roadway section. If the purpose is to calm traffic and reduce the operating speeds of traversing vehicles so that pedestrians and other road users may feel confident to share the road with moving traffic, then allowing for on-street parking may be favorable. To date, few studies have been conducted that examine these issues of context and operating speed on the safety of on-street parking.

TOWN CENTER PARKING STUDY

The groundwork for this investigation of on-street parking was derived from a combination of two separate research efforts. This first study focused on parking in six New England town centers. The second study explored the effect of roadside design features on driver speeds and safety from more than 250 roadway segments located in Connecticut.

Town Center Parking Study Methodology

The following three case study sites were chosen because they can be characterized as having traditional mixed land uses supported by a fee-based, organized system of parking featuring on-street parking along most streets:

1. Brattleboro, Vermont;
2. Northampton, Massachusetts; and
3. West Hartford, Connecticut.

Three more-contemporary sites in towns with income levels and demographics similar to that of the first set were then selected. The following sites are supported by free, privately owned surface parking lots with similar land areas and land uses:

1. Avon, Connecticut;
2. Glastonbury, Connecticut; and
3. Somerset Square in Glastonbury, Connecticut.

Two of the three contemporary sites have no on-street parking, and the third possesses on-street parking along less than half of one side of one street. This instance of on-street parking constituted approximately 3.6% of the parking in that single activity center. Overall, on-street parking accounted for 1.1% of the total parking at the contemporary sites and more than 11.0% at the traditional sites.

Following site selection, a boundary around each town center was established to designate the area of interest. The boundary lines incorporated each activity center's commercial district and any nearby parking lots meant to serve the downtown. Data detailing the provision of parking in each town center were then gathered. Each lot was mapped and categorized by the parking type. Parking lot types were initially broken into two main categories: public and private. The public municipal parking lots consisted of on-street parking spaces and off-street parking spaces, including both surface lots and structured garages. The private parking lots were open to the public and normally were outdoor surface lots.

Land use data on retail space, office space, and residential units were collected for comparison with each town's parking regulations and with the ITE manual on parking generation. The majority of on-site work consisted of parking lot occupancy counts carried out a minimum of five times at each site. This was done in an effort to collect what could be considered a typical peak use as well as an average nonpeak occupancy. Peak demand counts were collected principally during the busy holiday shopping season. The total number of pedestrians per site were also counted in conjunction with one parking occupancy count at each site to gauge the level of on-site activity.

The initial research paper detailed the amount of parking provided by each town in contrast with the amount required by zoning regulations and actual demand. Overall, the traditional sites provided less parking, used less parking, and used what parking they did have more efficiently in regard to occupancy as compared with the more contemporary sites (*10*). Every site provided less parking than required by the zoning regulations. The traditional sites provided approximately 45% of the parking required in the base regulations, and the contemporary sites provided 79%. And even though all sites provided less parking than required, results show a peak demand of just below 80% of the parking provided at the traditional sites; the contemporary sites were less than half full at peak. In addition to occupancy efficiency, the traditional sites were also less wasteful in regard to land dedicated to parking. For additional background information on the town center parking study, including topics such as land use, parking lot location, and pricing, please see the earlier paper (*10*).

Town Center Parking Study Results

Parking Demand

On the basis of a study of six town centers, the on-street parking spaces represented the most valuable parking spaces to the patrons of those activity centers. The table below displays these results:

	Peak Occupancy	*Avg. Nonpeak Occupancy*
On-street parking	94.5%	81.6%
Off-street surface parking	59.2%	48.8%
Structured garage parking	75.5%	49.4%

The on-street parking spaces were consistently in highest demand. This was true even though the on-street parking spaces charged higher fees than the off-street parking and had the shortest maximum time allotments. This combination of higher fees and the shortest maximum time allotment appeared to maintain high turnover in these most convenient spaces without negatively affecting use. The goal of the parking fees in general, especially for the off-street surface parking lots, seemed to be focused more on parking management and less on maximizing revenue. Nevertheless, parking demand for the on-street parking was consistently higher than for the off-street and garage parking lots.

Land Use

One often overlooked fact in assessing parking is its efficiency in regard to land use and cost. Data for the six centers show that on-street parking is by far the most cost-efficient way to provide parking. On-street parking typically uses less than 176 ft^2 (maximum space size is approximately 8 ft by 22 ft) per space compared with 513 ft^2 for each space in a surface lot. These values confirm the parking space land requirements estimated by Litman and Shoup that were discussed in the literature review. The difference is caused by the need to provide single-purpose driveways, access lanes, and often, landscaped islands for off-street surface lots. Although these features are necessities for off-street surface lots, they do result in significant land consumption. Figure 1 shows elements of this land consumption for an off-street surface parking lot compared with the much more efficient land use associated with on-street parking. Taking this difference in land utilization into account highlights the important role that on-street parking plays in ensuring that enough land is available in the center for more productive uses. To illustrate the point, if a town center with approximately 2,000 parking spaces, similar to the town centers in this study, were able to provide 15% of its parking curbside instead of with off-street surface lots, it would save more than 2.3 acres of land.

One outcome of being able to minimize unnecessary land used for parking is being able to devote more land to development. In fact, the traditional sites ultimately had

- 58% greater building density,
- 176% greater floor-to-area ratio, and
- 90% more leasable building space in each of the town centers.

The third approach to providing parking is through the use of parking garages. Parking garages use much less land area than either on-street parking or surface lots. Given that each of the traditional town centers also had one parking garage, this played a role in the increased development numbers. The trade-off in this case was in the high cost of constructing and maintaining the parking garage. For example, in looking at Brattleboro's 305-space parking garage, the cost of each parking space was approximately $29,508 in 2004 dollars (*11*). However, the true number of cars added by a parking structure should subtract the number of off-street surface lot spaces the same parcel of land could accommodate (*1*). As a result, the actual cost per parking space added to a town center by a parking garage is even higher.

Added congestion is often considered to be one of the costs associated with on-street parking. In reality, this is not a big price for most cities to pay. Various researchers, primarily studying road diet conversions, have shown that under most traffic conditions, actual road capacity is controlled largely by the capacity of the signalized intersections (*12–14*). Left-turn lanes and cross-street traffic volumes have more to do with the throughput of a road than the number of lanes devoted to moving traffic or the reduction in speed caused by the parking of vehicles. In addition, most urban settings embrace the vitality of the pedestrian environment created by slower-moving vehicles along the street segments. This vitality means that more people are choosing to walk (i.e., treating the area as a park once center), which works to reduce the amount of vehicle traffic that needs to be accommodated in the town center.

Assessment of the Pedestrian Environment

On-street parking is just one of many mechanisms that help create a specific atmosphere in an activity center. Other factors that have been discussed in the literature include street design, pedestrian connections, dense (and hence, compact) development, land use mixture, building orientation with respect to the street, setback requirements, and vehicle speeds; the combination of which, incorporated with on-street parking, can help create the desired town center atmosphere. In fact, the concept of on-street parking can easily be misapplied without taking into account the contribution of these supporting features.

Ideally in a study of this nature, it would be nice to find centers with various combinations of some features and not others, to separate out the contribution of each individual feature to the performance of the street and center. Unfortunately in this study design phase was found to be very difficult to achieve, especially given the resources available for carrying out the project. But even with unlimited resources, experience suggests that it would be a challenge to find centers with certain combinations of these features and not others. In general, on-street parking came as part of a package with these other features, including compact development and mixed land use. Therefore, in assessing the pedestrian environment it was necessary to be cognizant of the fact that the differences in the pedestrian environments seen are attributable to a larger number of complementary factors, of which on-street parking is just one.

In assessing the pedestrian environments, the first focus was how the centers were being used. It was found that the centers with on-street parking and other compatible features, including compact develop-

(a) (b)

FIGURE 1 Land use of off-street versus on-street parking: (*a*) off-street surface lot ~ 513 ft^2 per parking space and (*b*) on-street parking ~ 176 ft^2 per parking space.

TABLE 1 Mode Choice

Mode (%)	User Survey: Contemporary Sites (%)	User Survey: Traditional Sites (%)	2000 Census by Town for Work Trips: Contemporary Sites (%)	2000 Census by Town for Work Trips: Traditional Sites (%)	U.S. Average (2001 NHTS), Shopping Trips (%)
Driving	91.0	75.2	92.1	83.4	91.5
Public transit	1.4	6.9	1.1	2.3	1.4
Bicycling	0.2	2.5	0.4	1.6	0.3
Walking	7.4	14.8	0.7	8.3	6.5

ment, pedestrian connections, and street-oriented buildings, were much more vibrant in regard to pedestrian activities. The data showed that the traditional sites with on-street and other supporting conditions had more than six times the number of pedestrians walking around the site at similar times on similar days. The contemporary sites averaged fewer than 50 pedestrians, whereas the traditional sites averaged well over 300 pedestrians. These counts represent a snapshot of the number of pedestrians per site.

A part (but not all) of the explanation for this discrepancy is the difference in modes used for accessing the sites. Site users were questioned about the mode by which they traveled to the town centers, and this information was compared with mode choice worker data from the 2000 Census Transportation Planning Package for each location (*15*). The user survey data at the contemporary sites matched up remarkably well with the census data for a moderately sized survey. Table 1 highlights this information. Although the automobile was the prevailing mode choice for all sites, almost 25% of those traveling to the traditional sites did not use a car compared with just 9% at the contemporary sites.

Public transportation was used almost five times more at the traditional sites; this difference was noteworthy because the sites had similar levels of bus transit available. Nonmotorized walking and bicycling trips made up the remaining mode choices. Bike use reached 2.5% at the traditional sites compared with almost none at the contemporary sites. Other than driving, walking was the next most popular mode. The user survey found that almost 15% of trips to the traditional sites were walking trips, whereas people at the sites without on-street parking walked less than half that rate at 7.4%.

Most trips to the sites were for shopping purposes, based on the user surveys. For this reason, the mode choice results were compared with the U.S. average for shopping trips found in the 2001 National Household Travel Survey (*16*). This comparison showed not only how closely the user survey for the contemporary sites mirrored the national averages, but also how extraordinary the traditional sites turned out to be. Overall, users of the traditional sites walked more than twice the national average, used public transit more than four times the national average, and biked more than eight times the national average. Furthermore, the survey found that users of the traditional sites tended to always park once and walk to multiple errands, as opposed to those at the contemporary sites who did so only sporadically. Again, these trends are not directly attributable to on-street parking; however, the presence and use of on-street parking seemed to help contribute to differences in how the places functioned and how these places were used.

The considerable difference in pedestrian activities in the centers is one way of assessing the comparative pedestrian environments. However, established measures of pedestrian levels of service were also used to quantify this difference. On the basis of the pedestrian level of service model developed by Landis and the Florida Department of Transportation, the level of service (LOS) for the major streets in all three sites with on-street parking and other compatible factors was LOS B. Alternatively, the major streets in the three sites without on-street parking were LOS C, C, and D. This quantitative measure of the pedestrian environment correlated well with the level of pedestrian activity observed. However, this LOS measure does not seem to fully capture the qualitative difference in the pedestrian environment across the six centers.

SPEED AND SAFETY STUDY

The second portion of this paper investigates the impact of on-street parking on vehicle speed and traffic safety on the basis of more than 250 roadway segments located in Connecticut.

Speed and Safety Study Methodology

This study focused on identifying elements of the roadway and the driving environment that significantly influenced drivers' choice of speed. The predictor parameters of interest in this study were roadway type, land use type, posted speed limit, lane width, roadway width and shoulder width where present, on-street parking, planting strips, road edge delineation, side curbs, and medians. Other variables of interest in the study included the presence of sidewalks. For each site, a minimum of 100 free-flowing vehicle speeds were measured to represent the speed profile of the site. The estimated mean free-flow speed was measured as the dependent variable. The study suggested a strong correlation between free-flow speed and on-street parking.

On-street parking was measured at three levels of occupancy of the roadside with parking: 50%–100%, 30%–50%, and less than 30%. It was determined that the 50%–100% and the 30%–50% levels did not show any statistical difference in the mean free-flow speeds and were therefore merged into a single level recorded as significant on-street parking. The third level of less than 30% on-street parking was found not to be significant in affecting the free-flow speeds of the sites. The segment lengths of the roadways were determined by the consistency of the variables that were of interest for the study. Segments began and ended with the presence or termination of any or all of the variables mentioned. One of the observations noted during field data collection was that on-street parking was typically present or permitted at sites with a reasonably high level of pedestrian activity. For more background information on the speed study, please refer to the original paper (*17*).

Free-flow speed was used to ensure that the presence of other vehicles did not influence the drivers' choice of speed. The assumption made was that a driver's chosen speed is influenced only by the road and roadside conditions. For streets with significant on-street parking, the parking environment is the most prominent feature in the drivers' perception. In extracting the severity levels from the crash records, the severest injury for each crash was assigned as the severity level of that crash. Because of the naturally rare occurrence of crashes, the crashes for each road segment during a 6-year period (1998–2003) were aggregated so as to attain a reasonable count for statistical analysis.

Speed and Safety Study Results

Operating Speed and On-Street Parking

This study was conducted to determine the factors affecting the speed selected by drivers given the design of the road cross section and the roadway environment. Preliminary analysis of the data showed that it was useful to characterize the roadway into two types based on a package of cross-section design features. The two roadway types were designated streets and highways. The street type was typical of roadways found in an urban environment, whereas highway types were more characteristic of rural areas. With the definition used in this study, the primary distinction between streets and highways was that streets have no edge striping delineating shoulders whereas highways had shoulders. In addition, typically streets had raised, continuous, and nonmountable curbs, whereas highways mostly had mountable and intermittent curbs for drainage purposes. Streets also often had on-street parking, whereas highways often did not. These patterns however were not consistent for Connecticut because highway-type facilities were often found in an urban context where on-street parking might be appropriate.

This study using analysis of variance indicated that the design of the roadway and the road environment characteristics affected mean free-flow speed on roadway segments (*17*). Overall, the model explained about 80% of the variability in the mean free speeds chosen by drivers. One of the most important predictors of speed was road type—that is, whether the road was a street or a highway. Parameter estimates indicated that streets compared with highways resulted in speed reductions of about 1.5 mph. However, other factors were also significant in affecting the chosen speed. These factors included land use type, posted speed limit, building setback, the presence of a vegetated strip, and the presence of on-street parking. Table 2 displays these results.

For building setbacks, small setbacks registered a reduction in mean free-flow speed of 1.48 and 1.50 mph as compared with speeds on roadway segments with large setbacks. Similarly, the free-flow speed on streets with on-street parking found a reduction in speed of about 2.3 mph as compared with streets without on-street parking. The study showed that the largest decrease in speed occurred on those roadways with a combination of factors complementary to a street-type facility with smaller building setbacks and on-street parking. It was interesting to note that the three traditional centers in the town center parking study all exhibited these basic characteristics.

Road Safety and On-Street Parking

In this study of speed and road design, data on the traffic safety of the road segments were also collected. To examine the relative safety of roads with on-street parking, the focus was just on the roads that were defined as "streets" and not those that were defined as "highways." The reason for this was that a third of the streets had a significant level of parking compared with only about 3% of the sites classified as highways. As such, there was not a large enough sample of highways with parking to conduct a statistically rigorous analysis.

Previous studies of safety and on-street parking did not distinguish between high-speed and low-speed environments and did not separate crashes by severity. In this study, both were done. The streets were separated into low-speed and high-speed facilities and were analyzed separately. A speed of 35 mph was used as this delineation point because a very different outcome was found for facilities with speeds less than 35 mph versus those with speeds greater than 35 mph. For example, it was found that all the recorded vehicular fatalities occurred on facilities with speeds greater than 35 mph.

Table 3 summarizes the results of the road safety analysis. Results are given in crash rate per mile per site for (*a*) low-speed streets with parking, (*b*) high-speed streets with parking, (*c*) low-speed streets with no parking, and (*d*) high-speed streets with no parking. The numbers represent crash data aggregated for a 6-year study period. It was found that low-speed streets with parking had by far the

TABLE 2 Vehicle Speed: Full Analysis of Variance

Source	Type III SS	Degrees of Freedom	Mean Square	*F*	Significance
Corrected model	5,483.890[a]	14	391.706	66.027	0.000
Intercept	51,858.064	1	51,858.064	8,741.336	0.000
Posted speed limit	860.154	4	215.039	36.247	0.000
Roadway type	55.683	1	55.683	9.386	0.002
Land use	351.174	5	70.235	11.839	0.000
Presence of on-street parking	42.292	2	21.146	3.564	0.030
Building setback	87.053	2	43.527	7.337	0.001
Error	1,477.195	249	5.933		
Total	426,492.639	264			
Corrected total	6,961.085	263			

[a] $R^2 = 0.796$ (adjusted $R^2 = 0.781$).

TABLE 3 Crash Rates for Street Types

	Actual Speed	No. of Sites	Total Miles	Crash Rate/Mile/Site (1998–2003) Fatal	Severe	Minor	PDO[a]	All
Parking	Low speed (<35 mph)	13	3.06	0 (0%)	11.1 (3.8%)	47.7 (16.5%)	231.1 (79.7%)	289.9 (100%)
	High speed (35–40 mph)	5	1.45	0.7 (0.2%)	29.0 (8.5%)	89.7 (26.2%)	222.8 (65.1%)	342.1 (100%)
No parking	Low speed (<35 mph)	13	2.36	0 (0%)	28.0 (10.4%)	48.3 (18.0%)	192.0 (71.6%)	268.2 (100%)
	High speed (35–40 mph)	24	5.12	0.2 (0.1%)	17.2 (9.7%)	44.7 (25.3%)	114.8 (64.9%)	177.0 (100%)

[a]PDO = property damage only.

lowest rate per mile of fatal and severe crashes but not the lowest rate for all types of crashes. In other words, more than 96% of crashes that occurred on low-speed streets with parking resulted in either a minor injury crash or a property damage only crash; only 4% of the crashes on these low-speed streets resulted in severe injuries. On low-speed streets without parking, 10% of the crashes resulted in fatal or severe injuries. It is equally important to note that high-speed streets with parking generally had higher crash rates at all severity levels than all other street categories (only five street segments in this study fell into that category). However, this large discrepancy in safety outcomes between low-speed and high-speed streets with parking might be one of the reasons that these results differ from previous research in which no distinction was made on the basis of roadway speed.

These results point to the importance of considering context in assessing the potential for on-street parking, because a low-speed environment for on-street parking appears to be critical in ensuring safe use. Current thinking in street design supports this distinction. For example, the new ITE/Congress for the New Urbanism manual also recommends speeds of less than 35 mph for streets with on-street parking (*18*). In Europe, speeds on urban streets are often kept at less than 20 mph (*19*). The present results suggest that under these low-speed conditions, on-street parking helps improve safety, and in particular, these roads with on-street parking show a significantly reduced crash rate for the most severe types of crashes.

Results show that streets can be actively designed to limit speed. The provision of on-street parking is one factor that helps to reduce speeds, but on-street parking by itself is not enough. In fact, on-street parking without the other supportive conditions may be counterproductive and result in extremely unsafe conditions. This suggests that for the best results in regard to creating safe low-speed conditions, on-street parking should be part of a package that includes a street-type design (i.e., raised curbs, small building setbacks, sidewalks, vegetated buffer strips, and no shoulders).

CONCLUSION

This investigation points to on-street parking as playing a crucial role in benefiting activity centers on numerous levels. Users of the downtowns consistently selected on-street parking spaces over and above less expensive off-street surface lots and garage parking. These shared on-street spaces served a wide variety of uses while experiencing the most use and the most turnover. On-street parking also resulted in a more efficient use of land. Using the curbside for parking saves considerable amounts of land from life as an off-street surface parking lot; with land being a limited resource, this issue is particularly important in areas in which density and high activity are desired. Therefore, the benefit of being able to conserve more than 2 acres of land in small to medium town centers by providing parking on the street rather than with an off-street surface lot is immense. This efficiency in land use can allow for a much higher density commercial development than is possible if the center is to rely solely on off-street surface lots to meet all its parking needs.

On the basis of the observed variation in activity patterns in the centers studied, on-street parking offers pedestrians a safer and more comfortable environment. The strip of parked vehicles along the curbside serves as a buffer to pedestrian activities immediately beyond the curbside. Study results show that centers with on-street parking and other compatible characteristics, such as mixed land use and higher density, recorded more than six times the number of pedestrians walking around compared with the more contemporary sites, which in general lacked these traits. All other things being equal, higher-density developments with fewer large, half-empty off-street surface lots to traverse are intrinsically more walkable. These types of advantages are factors in creating vibrant places in which more people walk and bike to, and within, the town centers.

Results suggest that on-street parking can also help to create a safer environment. Although this statement seems to contradict some existing research, the reality is that lower-speed roads (less than 35 mph) with on-street parking have far fewer severe and fatal crashes. In fact, lower-speed streets without parking had a severe and fatal crash rate more than two times higher than the streets with parking. It was also shown conclusively that drivers tended to travel slower in the presence of features such as on-street parking and small building setbacks. Slower vehicle speeds provide pedestrians, cyclists, and drivers with more time to react, and when a crash does occur, the chance of its being life-threatening is greatly reduced.

Considering the current trend toward harmonizing the conflicting demands of transportation facilities, the results of this study could inform efforts in creating pedestrian-friendly streetscapes that support vibrant centers. On-street parking is not purely a device to be used in the right environment; rather, it is also a tool to help create that right environment. On-street parking should be used more commonly but especially in situations in which the street is part of the destination and the intent is to cause drivers to slow down and recognize that they have reached a place. Results show that these places with on-street parking tend to be safer and more walkable, require less parking, and have much more vitality.

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