EFFECTS OF SITE DESIGN ON PEDESTRIAN TRAVEL IN MIXED-USE, MEDIUM-DENSITY ENVIRONMENTS

(Summary of Findings and Recommendations with Selected Figures)

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I. SUMMARY OF FINDINGS AND RECOMMENDATIONS

RESEARCH DESIGN AND DEFINITIONS

This project demonstrates that pedestrian volumes are related to site design. A quasi-experimental method was used to study 12 neighborhood sites with commercial centers in the Puget Sound region. The sites selected were controlled for four basic variables that previous research has identified as factors that affect pedestrian trip volumes. These variables were as follows:

- population density (the higher the density the larger the potential "market" of pedestrians)
- income (the higher the income, the easier the access to an automobile, which acts as a disincentive to walk)
- land-use type and mix (defining appropriate origin and destination of the pedestrian trip)
- a one-half-mile radius area within which all of the above variables are spatially contained (this distance, which defines an area of approximately 500 acres, is appropriate for pedestrian travel).

Under these controlled conditions, all the 12 sites were selected for their high potential to support pedestrian travel. Each site had a gross residential density of 10 people to the acre or greater and contained all of the retail facilities necessary for daily living. In other words, each site had a concentration of commercial land uses that defines a neighborhood commercial center, as well as an average of 6,000 people living in apartments and single houses within a one-half-mile radius of the center. In all 12 sites, approximately half of the dwelling units were located within a third of a mile of the neighborhood center.

However, half of the selected sites exhibited site design characteristics that were supportive of pedestrian travel, whereas the other half of the sites did not (dependent variable). Site design characteristics that support pedestrian travel are defined by small blocks and by continuous and connected sidewalks. Site design characteristics that do not facilitate pedestrian travel are defined by large blocks and by few, often discontinuous and disconnected, pedestrian facilities.

To facilitate the discussions of site design characteristics, the six sites with supportive site design characteristics were called "urban (u)," and the six sites whose site design was not supportive of pedestrian travel were called "suburban (s)." The distinction between urban and suburban focused on site design characteristics that were readily measurable and related directly to the pedestrian environment: specifically, the presence or absence of sidewalks (measures of pedestrian facilities completeness) and the distribution of those sidewalks (measures of pedestrian facilities extent).

In this study, the urban sites (u) had the following site design characteristics:

- mean block sizes of 2.7 acres (the equivalent of a 300- by 400-foot block)
- complete and continuous public sidewalk systems on both sides of all streets.

Suburban sites (s) had the following site design characteristics:

- mean block sizes of 32 acres (the equivalent of a 1,000- by 1,300-foot block)
- incomplete and discontinuous public sidewalk systems that, on average, lined less than half of the streets of the sites. (See figures 26a and 27a)

Under this definition of "urban" and "suburban," many cities in the Puget Sound actually exhibit "suburban" characteristics. For example, more than half of the residential areas of Seattle do not have sidewalks and could, therefore, be classified as suburban according to our definition. However, to ensure the clarity of research results given the small 12-site sample, the sites selected reflected only the two extremes of urban and suburban site design characteristics; that is, there were no sites with mixed characteristics, such as sites with small or medium-sized blocks but no sidewalks. As a result, all 12 sites selected

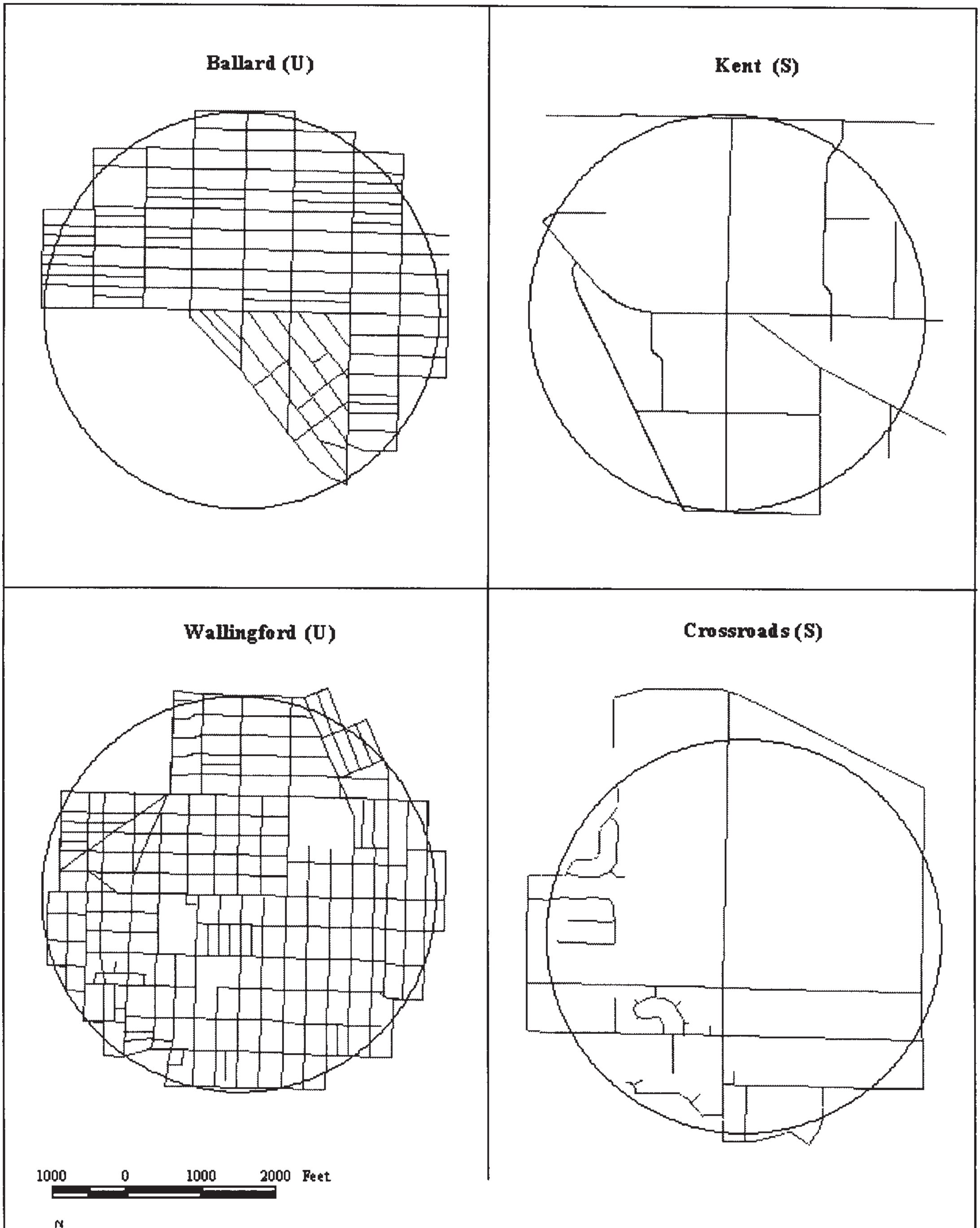


Figure 26a. Street Networks for Ballard, Kent, Wallingford, and Crossroads

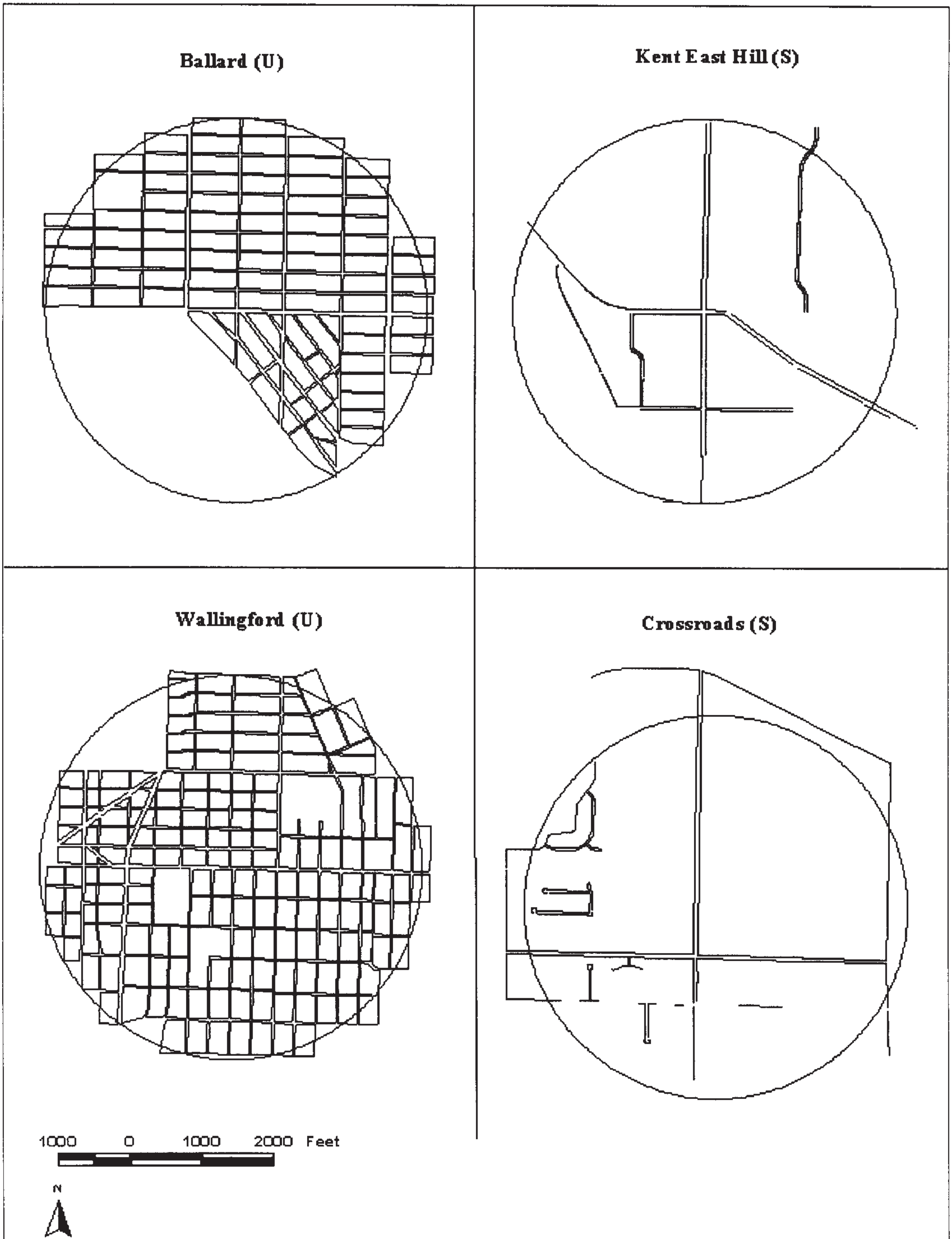


Figure 27a. Sidewalk Networks for Ballard, Kent, Wallingford, and Crossroads

could be readily classified as either urban and suburban. They also exhibited other features that commonly distinguish between urban and suburban design characteristics, such as buildings oriented toward and situated next to streets in the case of urban sites, and buildings considerably set back from the streets and often oriented toward parking lots in suburban sites.

Finally, only a limited number of sites in the Puget Sound region could fit within the control and independent variables. As a result, the 12 sites selected were categorized and matched according to the size of their commercial centers, with size being defined by the number of businesses and types of retail facilities provided within the one-half mile pedestrian catchment area. There were four groups of sites: two groups of two sites with a large commercial center, one group of five sites with a medium-sized commercial center, and one group of three sites with a small commercial center. Areas defining the commercial center varied in size from 21 to 122 acres. All had at least one traditional grocery store. In urban sites, retail facilities lined one main street in single-story structured or mixed-use multi-story buildings. In suburban sites, retail facilities were spread through large blocks of private land dominated by parking at grade.

Pedestrians were counted as they left residential areas to enter the neighborhood commercial area.

FINDINGS

Table 1 summarizes the site characteristics and pedestrian volumes found.

1. Relationship Between Pedestrian Volumes and Site Design

Pedestrian Volumes Are Related to Site and Pedestrian Facilities Design

This project showed that the three measures traditionally employed to predict pedestrian volumes—population density, income, land-use distribution and intensity—are, individually and together, insufficient to explain pedestrian volumes; site design,

Table 1. Summary of Site Characteristics and Pedestrian Volumes

Site		Gross Population Density	Number of businesses within cordon	Median Income	Length of Streets (mi)[1]	Length of Sidewalks (mi)[1]	Sidewalk completeness[2]	Mean block size (acres)	Mean distance between entry points (ft)[3]	Median Airline Distance (mi)[4]	Mean Route Length (mi)	Route Directness[5]	Observed Pedestrians per hour	Pedestrians per hour per 1,000 residents	Pedestrians per hour (complete site)[1]
Urban Sites															
Ballard		14.1	205		28.0	40.4	100%	2.5	633	0.33	0.40	1.24	299	50	355
Madison Park		14.2	46		23.3	30.4	100%	3.7	483	0.20	0.31	1.23	152	42	296
Proctor		9.6	63		35.2	32.9	83%	2.6	632	0.36	0.43	1.25	105	24	105
Queen Anne		14.7	68		30.9	39.4	100%	2.1	523	0.33	0.43	1.29	360	52	379
Wallingford		15.7	82		30.9	44.4	100%	1.8	635	0.27	0.36	1.32	271	36	280
West Seattle		11.9	63		30.7	38.0	100%	2.7	397	0.36	0.44	1.28	118	22	130
Urban Average		13.4	88												
Suburban Sites															
Crossroads		12.3	96		7.9	7.7	63%	45.5	1,124	0.36	0.54	1.49	112	16	98
Juanita		12.9	44		13.3	10.1	45%	15.3	820	0.27	0.49	1.76	41	8	50
Kent East Hill		13.6	110		6.5	6.1	57%	48.6	1,210	0.45	0.66	1.57	85	12	79
Kingsgate		11.5	30		14.1	16.0	64%	15.1	640	0.29	0.47	1.57	54	9	52
Mariner		13.0	55		8.4	5.7	44%	29.8	919	0.29	0.54	1.80	78	16	103
Oakbrook		12.4	70		9.4	1.1	9%	35.8	1,345	0.28	0.50	1.77	40	14	85
Suburban Average		12.6	68												
Average All Sites		13.0	78												

1. Measured for a “complete site,” that is a hypothetical site developed at the same densities and with the same physical characteristics over an area of 500 acres.
2. Sidewalk completeness is measured as a ratio of the length of the sidewalk system to the length of all public street frontage.
3. Mean distance between pedestrian entrances into commercial center at cordon boundary.
4. Fifty percent of housing units are within this distance of the “100 percent” location of each commercial center.
5. Route directness is measured as the ratio of average route length to average airline distance.

Sources: U.S. Census of Population and Housing, 1990; field data.

specifically block size and the extent of pedestrian facilities provided, must also be considered.

- All urban sites studied had a higher volume of pedestrians than the suburban sites studied. On average, urban sites had three times as many pedestrians as suburban sites.
- The urban sites with the lowest pedestrian volumes had over twice as many pedestrians as the suburban sites with the lowest pedestrian volumes, and 40 percent more pedestrians than the suburban sites with the highest pedestrian volumes.
- The suburban sites with the highest pedestrian volumes had fewer than a third the number of pedestrians than the urban sites with the highest volume of pedestrians.

People Do Walk in Suburban Areas

Contrary to popular belief, a substantial number of people walk to suburban neighborhood centers; between 50 and 102 pedestrians per hour were observed entering suburban centers. This translates to 8 to 16 people walking into the local commercial center per hour for every 1,000 residents living within one-half mile of the center (figures adjusted for comparability purposes).

Pedestrian Volumes Are Not Related to the Size of Neighborhood Commercial Center

In urban sites, both the lowest and highest pedestrian volumes corresponded to sites with medium-sized commercial centers. In suburban sites, the lowest pedestrian volumes were found in the sites with the smallest commercial centers. However, the largest site had fewer pedestrians than any of the medium-sized center sites.

The Distinction Between Urban (U) and Suburban (S) Carries the Most Explanatory Power in Defining Pedestrian Volumes

Variations within site design and pedestrian facilities measures used do not, in and of themselves, explain variations in pedestrian volumes within either urban or suburban site categories. Measures such as block size, total length of street and of sidewalk systems, the completeness of the sidewalk systems, and the directness of pedestrian routes are not linearly related to pedestrian volumes. Other variables come into consideration, such as variations in population density, income, and size of retail center, none of which are linearly related to pedestrian volumes, either. In this study, the combination of variables that described the distinction between urban (U) and suburban (S) site and pedestrian design characteristics was the best predictor of differences in pedestrian volumes. As a result, further analyses of the 12 sites divided them accordingly. (Figure 40)

2. Profiles of Pedestrians

Many Young Pedestrians in Suburban Areas

The distribution of pedestrians by age was closely related to the census population in urban sites. In suburban sites, however, a disproportionate number of young people (under 18) was walking. On average, the proportion of young people walking to all people walking was 180 percent higher than the proportion of young people in the census population living in suburban sites. An average of 41 percent of the suburban pedestrians were young in comparison to 16 percent in urban sites, and in three of the suburban sites, young people constituted the majority of pedestrians counted. (Figure 42)

Many Pedestrians of Color in Urban and Suburban Areas

A disproportionate number of people of Color was walking in both urban and suburban sites, with averages of more than 200 and 240 percent of the corresponding census populations in urban and suburban sites, respectively. On average, urban pedestrians of Color constituted 10 percent of the total number of pedestrians, versus 29 percent in suburban sites.

The uneven distribution of young pedestrians and pedestrians of Color in suburban sites raises serious questions regarding the safety of people who cannot or do not want to drive. Furthermore, pedestrian with impairments were found in three of the suburban sites.

Figure 40. Pedestrian Trip Volumes by Site Design Measures

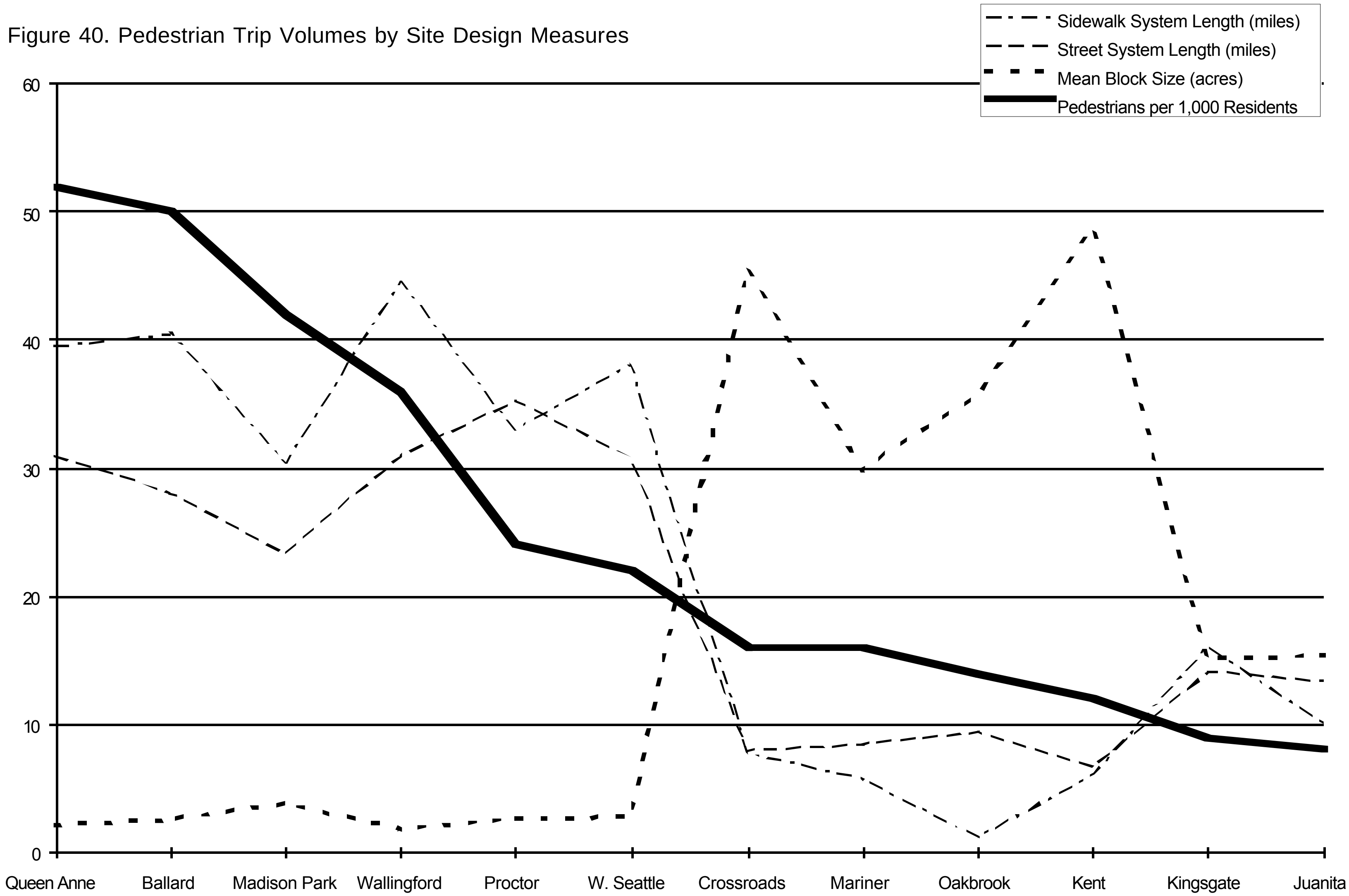


Figure 42. Pedestrian Trip Volumes by Age, Comparison to Census Population

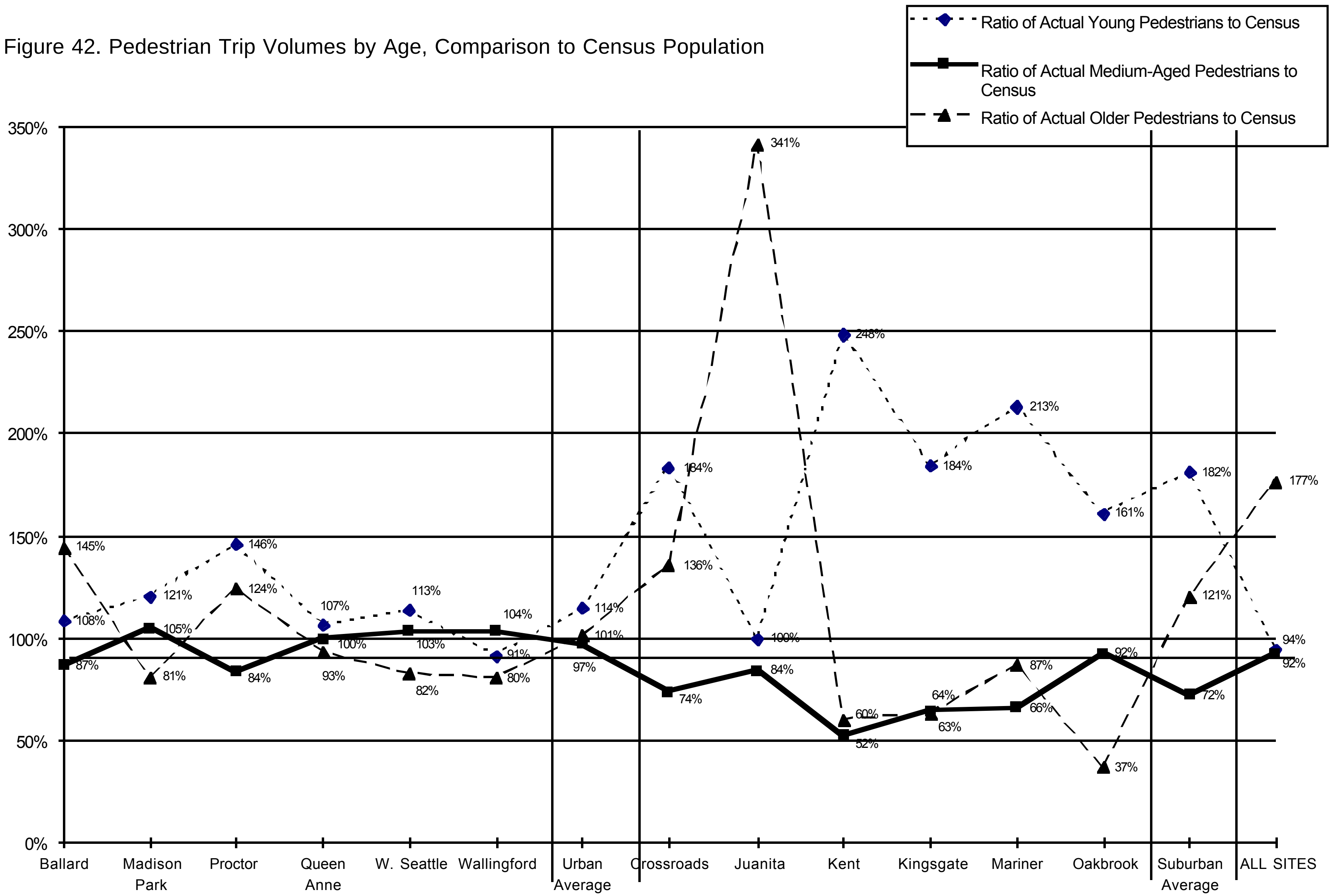
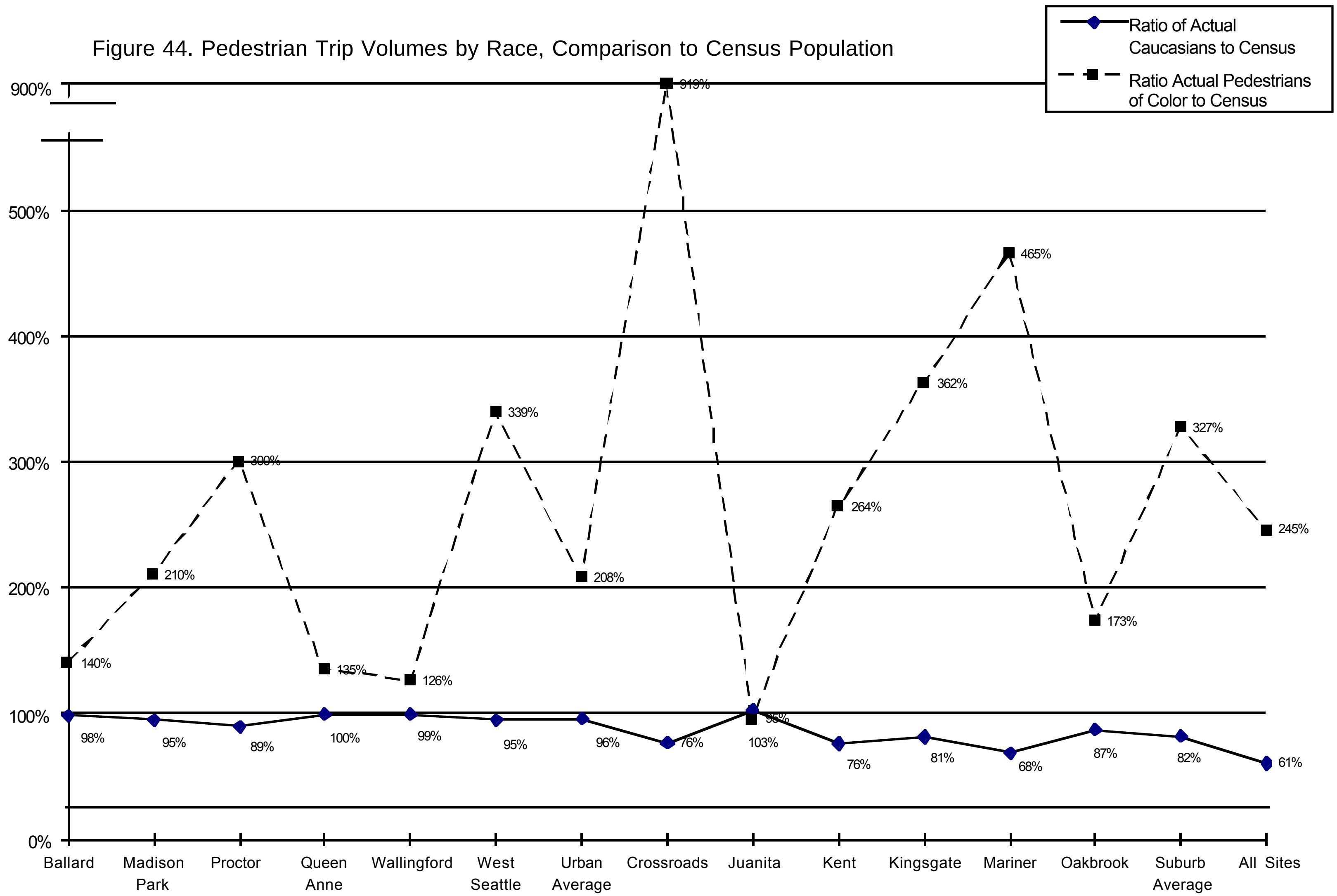


Figure 44. Pedestrian Trip Volumes by Race, Comparison to Census Population



These figures point to the importance of providing facilities that support safe pedestrian travel in suburban areas. (Figure 44)

3. Where People Walk

Most People Walk on Streets with Sidewalks

Seventy-eight percent of all pedestrians entered the commercial center on a street with sidewalks. In urban areas, 98 percent of the pedestrian trips were on streets with sidewalks, versus 60 percent in suburban areas. Streets with sidewalks constituted only 43 percent of the possible entry points into suburban commercial centers, indicating that many people choose to use sidewalks.

Most People Walk along Wide "Main" Streets

In urban sites, 41 percent of the pedestrians entered the commercial area on streets wider than 48 feet--those representing only 26 percent of the possible points of entry into the commercial center. In suburban sites, 71 percent of the pedestrians used streets wider than 36 feet, representing 55 percent of the possible entry points.

High Incidence of Jaywalking

Only 38 percent of the pedestrians entering a suburban commercial center crossed a street, versus 56 percent in urban sites, reflecting the different site design characteristics of the sites. Of those pedestrians who crossed a street at the point of entry into the commercial area, 32 percent were jaywalking in suburban sites, whereas 20 percent jaywalked in urban sites. Although jaywalking is relatively safe in urban sites, where most streets are narrow and automobile traffic is tamed, it represents substantial risk-taking on the part of the suburban pedestrian; suburban jaywalking is often across wide, heavily trafficked streets. The high incidence of jaywalking in suburban sites points to a major safety problem and indicates that pedestrians lack options in their walking routes.

Of those pedestrians who crossed a street as they entered the commercial center, 14 percent used a marked crosswalk in urban sites versus 60 percent in suburban sites, again reflecting the fact that people prefer safe pedestrian facilities whenever they are available.

(Suburban intersections are so wide that a marked crosswalk is needed to protect pedestrians.)

Schools Generate Pedestrian Traffic

The presence of schools corresponded to high volumes of pedestrians in all of the three suburban sites and two of the five urban sites that had a school located near the commercial center.

Apartments and Grocery Stores Generate Pedestrian Traffic

In both urban and suburban sites, the distribution of pedestrians entering the commercial center showed a positive relationship between pedestrian volumes and dense housing and commercial activity. This relationship was especially strong when dense housing directly adjoined a grocery store. It appears, therefore, that, contrary to popular belief, a significant amount of grocery shopping is done on foot.

4. Land-Use, Site and Pedestrian Facilities Design Characteristics of Suburban Sites

The Small Suburban Center as a Significant Element of Future Transportation Planning

This project unexpectedly identified some 50 small concentrations of activity spread throughout parts of the region that have been developed since the 1960s. Although many of these concentrations do not appear to host the mixes of land uses necessary to make viable neighborhood commercial centers, the relatively high population densities or densities of retail and office development all call for further research regarding the potential of these concentrations to support a balanced transportation policy.

Compact Suburban Centers

Within the pool of selected sites, suburban sites were as compact as their urban counterparts, with, on average, 50 percent of the dwellings units falling within a third of a mile or less of the 100 percent corner in the commercial center. This indicates that land-use distribution and intensity in suburban sites are potentially as conducive to pedestrian travel as those in urban sites.

Indirect Pedestrian Travel Routes in Suburban Areas

The average actual route length traveled by pedestrians was approximately 600 feet longer in suburban than in urban sites. In urban sites, 50 percent of the residential dwellings were within a travel distance of 2,100 feet of the commercial center, versus more than 2,700 feet in suburban sites. Pedestrian travel routes between residential and commercial uses were 27 percent longer than airline distance in urban sites, whereas they were 66 percent longer in suburban sites. This indicates that site design and facilities are inefficient for pedestrians in suburban sites. The reasons behind these inefficiencies are explained below.

Inefficient Transportation Infrastructure in Suburban Areas

The size of suburban blocks was inversely related to the intensity of land uses contained by those blocks. The largest blocks contained the highest intensity land uses, such as apartment complexes and commercial areas. Thus, the blocks that generated the most trip making and were used by the highest numbers of people had the fewest streets and sidewalks. Instead of taking into account the number of people who will use the streets, suburban blocks correspond to the size of the properties they serve: blocks for single-family development are relatively small at less than ten acres (a 200- or 300-foot wide and 600- to 1,000- foot long block), whereas blocks for multi-family and commercial development vary from 40 to 100 acres (corresponding to blocks that are more than 2,100 feet on a side, or more than 30 times the size of an equivalent urban block). Clearly, suburban block size does not to address transportation demand for either motorized or non-motorized modes.

Sidewalks

Sidewalk systems in suburban sites were only one-fifth of the length of systems found in urban sites. Furthermore, sidewalks in suburban sites did not generally correspond to areas of concentrated residential or commercial activity. They were found along many of the streets that serve single-family dwellings and along arterials. However, because arterials form very large blocks, the sidewalk network that they provided was too coarsely distributed for pedestrian travel. On average, sidewalks in suburban sites were present along only half of public streets.

Distance Between Points of Entry into the Commercial Center

The mean distance between points where pedestrians could enter the commercial center was twice as long in suburban than in urban sites. The longer this distance, the fewer the points of entry into the commercial areas. At 550 feet in urban sites, this distance is already too long to provide efficient travel options for the pedestrian.

The inefficiencies of pedestrian facilities in suburban sites can be remedied as outlined in the recommendations below.

RECOMMENDATIONS

This study's findings show that it is imperative to address pedestrian safety issues and to improve the infrastructure supporting pedestrian travel in suburban areas by providing appropriate facilities. Specifically, the following findings are significant:

- the comparatively high numbers of people walking in these areas
- the disproportionately high number of young pedestrians and pedestrians of Color
- the comparatively high numbers of pedestrians using streets with sidewalks in spite of the low incidence of such streets
- the high numbers of pedestrians jaywalking in spite of the dangerous conditions found on the wide, automobile-oriented streets found in suburban areas.

The provision of additional pedestrian facilities in suburban areas also may increase pedestrian volumes and help reduce local auto congestion by encouraging people to substitute walk trips for auto trips. Because the vast majority of transit riders access public transportation by foot, developing appropriate pedestrian facilities is also relevant to supporting the use of public transportation.

Our recommendations fall into two categories: the need to identify suburban areas where land uses already exhibit characteristics that are conducive to pedestrian travel, and the need to apply site design guidelines to support the development of safer and shorter pedestrian travel routes.

Need to Identify Location and Type of Small Suburban Concentrations of Activity

The analysis of the Puget Sound Region undertaken in the site selection phase of this project pointed to many suburban areas that have population density higher than 12 people per acre, and which, as a result, have a potentially large "latent" pedestrian market. There is a need to identify these areas, which are not commonly recognized by planning authorities, and to improve their pedestrian facilities.

Need to Devise Site Design Guidelines to Support Pedestrian Travel

New guidelines and regulations need to address the retrofitting of existing areas as well as new development. The goal of the guidelines and regulations would be to provide safer and shorter routes for pedestrians to use between major land uses—residential, commercial, and school facilities. The two principal impediments to short and efficient pedestrian travel in suburban centers are the large size of blocks and the lack of sidewalks or safe pedestrian pathways. Sites with a concentration of mixed land uses and activities need to offer a continuous network of safe walkways that allow people to walk between those land uses and activities. Given this study's findings, this network should build on existing arterials as well as on the informal paths that pedestrians have already established. The following simple measures will help to develop this network and to improve considerably the pedestrian environment in suburban centers within reasonable costs.

- Provide sidewalks along all arterials and streets in and around the commercial center and the ring of apartments surrounding the center itself. Sidewalk width needs to recognize that most pedestrians prefer to use sidewalks. They must be commensurate with the width of the street or arterial, and protective elements should be placed whenever the speed of traffic constitutes a danger to the pedestrian.

- Provide marked crosswalks at all street and arterial intersections. Where traffic lights are included, provide pedestrian push buttons, and adjust pedestrian green light time to the width of the street and arterial.

Marked crosswalks should occur at least every 500 feet along streets and arterials that serve concentrations of apartments, commercial development, and schools to discourage and reduce the incidence of jaywalking. Crosswalks must be accompanied with the appropriate signage to make drivers aware of the presence of pedestrians.

- Provide gates in fences surrounding apartment complexes and schools. Because they act as de facto “street intersections," these gates should occur at regular intervals, likely every 200 feet, especially when the fence is located along the edge of the commercial center or along the arterials bordering the complex. The gates can be locked and keyed to the apartment complex entryways for security purposes.
- Provide marked pedestrian walkways leading people in and out of the gates, on both the apartment and the commercial center sides, to ensure a safe environment for the pedestrian.

Marked walkways in both apartment complexes and commercial centers should form a continuous network, identifying the shortest and most practical distances between residential and commercial building entries. The walkway network should connect to gates in fences and to sidewalks along arterials. It should be designed as a de facto pedestrian street network within the outdoor area of apartment complexes and within the parking lots of commercial areas. The network should form a simple grid adapted to the topography that connects every building entrance to the rest of the system. A 200-foot grid is appropriate for pedestrian travel. This grid can be adjusted to correspond to parking lot design and to support drivers within either the apartment complexes or the commercial center.

It is important that the grid of pedestrian pathways continue to the sidewalks along the arterials that surround the commercial center. Shoppers on foot need to be able to reach the sidewalks along the streets or arterials at small, regular intervals, not only at curb cuts designed for automobile traffic.

The network should take into account the fact that grocery stores tend to attract pedestrian traffic. It should also include safe and direct pedestrian routes between schools facilities and commercial land uses, especially as older school children tend to gravitate to these facilities.