Pedestrian Level of Service Based on Trip Quality

Frank Jaskiewicz
Glatting Jackson Kercher Anglin Lopez Rinehart, Inc.
123 South Broad Street, Suite 1270
Philadelphia, PA 19109
fjaskiewicz@glatting.com

ABSTRACT

The pedestrian experience is dependent upon numerous qualitative factors that are not addressed in customary level-of-service analyses. This paper outlines a process by which such factors can be used to analyze pedestrian systems. Nine specific evaluation measures are described, followed by an account of their application in Winter Park, Florida.

INTRODUCTION

The pedestrian environment is a critical element of the urban experience. Allan B. Jacobs, in his book *Great Streets*, explains the importance of pedestrian facilities (Jacobs 1993).

> It's on foot that you see people's faces and that you meet and experience them. That is how public socializing and community enjoyment in daily life can most easily occur. And it's on foot that one can be most intimately involved with the urban environment: with stores, houses, the natural environment, and with people.

The pedestrian experience entails much more than traveling from point A to point B. As a result, it is important that analyses of pedestrian levels-of-service (LOS) take into account *qualitative* factors as well as traditional volume and capacity considerations. Amos Rapoport, in his book *History and Precedent in Environmental Design* (1990), along with Allan Jacobs, describes design principles that help constitute pleasant pedestrian spaces. This paper combines these urban design architectural principles with practical safety and capacity considerations to generate nine specific evaluation measures for analyzing pedestrian systems for their pleasantness, safety, and functionality.

The proposed nine measures are as follows: enclosure/definition, complexity of path network, building articulation, complexity of spaces, transparency, buffer, shade trees, overhangs/awnings/varied roof lines, and physical components/condition. Each of these nine measures is derived from a combination of safety issues, volume and capacity considerations, and qualitative design factors as adapted from Rapoport and Jacobs.

The proposed measures vary in their degree of specificity. Where certain design parameters can be applied universally—i.e., regardless of geographical location—then very specific guidelines are proposed. Where the proper implementation of principles is heavily dependent upon the specific physical characteristics of a particular location, then only general recommendations are possible. In these cases, it is important that the application of the recommended principles conform to prevailing location-specific design attributes to ensure that the overall existing character of the area is not degraded.

RATINGS AND AGGREGATE LOS VALUES

A simple ratings scale can be applied to assess the degree to which certain target areas conform to the nine proposed evaluation measures. A scale of 1 to 5 is sufficient to accurately cover the range of conformance: 5 = excellent; 4 = good; 3 = average; 2 = poor; 1 = very poor.

If desired, the scores can subsequently be aggregated and averaged to obtain an overall LOS, with the following ranges and general characteristics (maintaining an LOS A through F scale as typically utilized to describe travel environments):

LOS A = 4.0 to 5.0 = very pleasant
LOS B = 3.4 to 3.9 = comfortable
LOS C = 2.8 to 3.3 = acceptable
LOS D = 2.2 to 2.7 = uncomfortable
LOS E = 1.6 to 2.1 = unpleasant
LOS F = 1.0 to 1.5 = very unpleasant

The final interpretation of these LOS values is not directly parallel to that for their vehicular counterparts. In terms of *vehicular* LOS assessments, LOSs C through E generally serve as appropriate standards for planning purposes, depending upon the particular context (i.e., peripheral highway vs. town center). In terms of *pedestrian* facilities, on the other hand, appropriate planning-level guidelines are represented by LOSs A through C, with LOS A serving as the standard for town centers and LOS C for fringe roadways. Pedestrian LOS D may be permissible in specific cases (for instance, for seldom-traveled outlying highways), so long as basic safety parameters are observed.

Because of greatly varying pedestrian contexts, aggregate LOS values should only be applied to attain a general level of prioritization. For other purposes, it is more useful to keep the nine scores separate so that specific deficiencies can be catalogued. For example, a pedestrian LOS E would indicate that a particular roadway segment requires considerable improvement, but would say nothing about how to best address the deficiency. On the other hand, if it is documented that the roadway scored a "1" on *shade trees*, then it becomes apparent that the planting of trees is likely to be a promising course of action.

In Winter Park, Florida, as will be chronicled later in this paper, aggregate LOS measures were never assigned. Instead, the scores for each of the nine measures were published separately and specific actions recommended based upon a combination of these nine individual scores and public input. The result was a very specific pedestrian improvement plan for the city's thoroughfares and neighborhoods.

NINE PEDESTRIAN EVALUATION MEASURES

The nine proposed evaluation measures are based upon *aesthetics, safety,* and *ease of movement* and are critical to the provision of high pedestrian levels of service defined in this paper. These measures attempt to extend the scope of most contemporary methodologies for determining pedestrian level of service to account for aesthetics and safety in addition to volume and capacity.

Because the pedestrian experience entails much more than simply a "commuting" function, it is important that planners and engineers be able to identify the elements that distinguish a good pedestrian environment from a poor one. The following pages describe and illustrate nine specific evaluation measures that highlight certain important aspects of pedestrian planning.

Enclosure/Definition

The principle of *enclosure* measures the degree to which the edges of the street are defined. Good enclosure dictates that the pedestrian's eyes are focused *along the street* rather than among the blank spaces between, behind, or in front of buildings.

Commercial streets best demonstrate enclosure when buildings are constructed side-by-side along the sidewalk, minimizing the volume of empty space between and in front of buildings. Figure 1 shows, in plan view, the difference between a well-enclosed commercial street and a poorly enclosed one. A pedestrian on the well-enclosed street is greeted by a continuous row of pedestrian-scale storefronts, while a pedestrian on the poorly enclosed street is met by an overabundance of empty space—mostly parking lots—and is dwarfed by the vast distances between interesting elements.

Residential streets, especially those comprised mainly of single-family dwellings, derive enclosure primarily from street trees rather than from structures. Street trees enable the roadway to retain definition even given the larger setbacks and greater building spacing typical of purely residential areas as compared with commercial or mixed-use town centers, so long as these elements are consistent along the corridor.

According to Jacobs, a cross-sectional design ratio of approximately one (height) to two (width), or less, creates good definition along the street. Where such a ratio is not attained with structures, Jacobs contends that: "it is the intervening trees as much as or more than buildings that strengthen or provide definition. That is one of their purposes and speaks to the necessity of their closeness and fullness" (Jacobs 1993).

Good enclosure has positive impacts on safety as well as on aesthetics. Streets that exhibit a high degree of enclosure convey a feeling of *narrowness* to motorists, which induces them to drive slowly and carefully for fear of collision with solid objects framing the roadway. Conversely, wide-open, unconstrained spaces invite high speeds, creating hazardous conditions for children at play as well as for pedestrians and bicyclists.

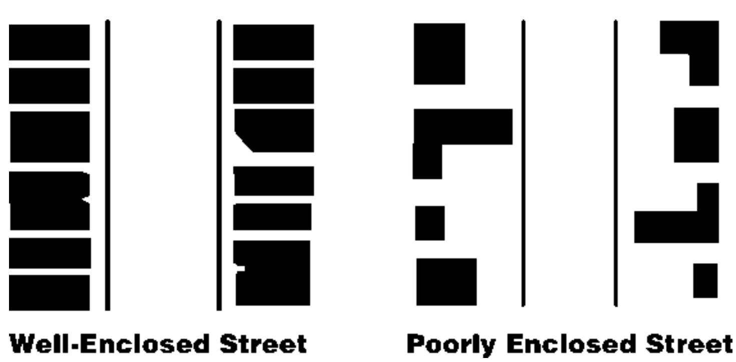


FIGURE 1 Enclosure/definition.

An additional pedestrian safety benefit of good enclosure is that buildings located continuously along the sidewalk provide “eyes on the street” which discourage criminal activity. A side-by-side arrangement of buildings also limits the number of dark, scary hiding places between structures that are difficult to monitor, and reduces the overall number of escape routes available to aspiring criminals.

Complexity of Path Network

A complete/complex path network furnishes pedestrians with numerous route choices between origins and destinations. In other words, a complex path network ensures a high degree of connectivity between activity centers and residential units. Without a complex path network, pedestrians are often held hostage to the same route day after day, making even the most pleasant of paths very tiresome. Figure 2 illustrates a poor, incomplete path network in comparison to a complete, complex network, the former of which is all too commonly found in contemporary suburban areas.

A poorly connected path network, in addition to its failure to provide adequate alternate routes, in many cases funnels pedestrians onto a single circuitous path that does not typically represent the shortest distance between two points. Unfortunately, when public infrastructure is not designed to preserve a reasonable density of pathways through an area, the shortest distance, and all tolerable approximations thereof, are often cut off by private property. Such a condition is very frustrating to pedestrians and, for obvious reasons, does not encourage walking as a viable alternate form of transportation.

Building Articulation

Storefronts and houses add interest to the pedestrian experience through the varied application of materials, design, color, and décor. The best examples are found in historic town centers and close-in neighborhoods where structures were originally designed to appeal to slow-moving pedestrians rather than to high-speed automobile traffic, since walking was for a very long time the dominant form of transportation between homes and businesses.

Conversely, in most contemporary strip mall corridors, structures and billboards are designed to appeal to high-speed vehicular traffic rather than to low-speed foot traffic.

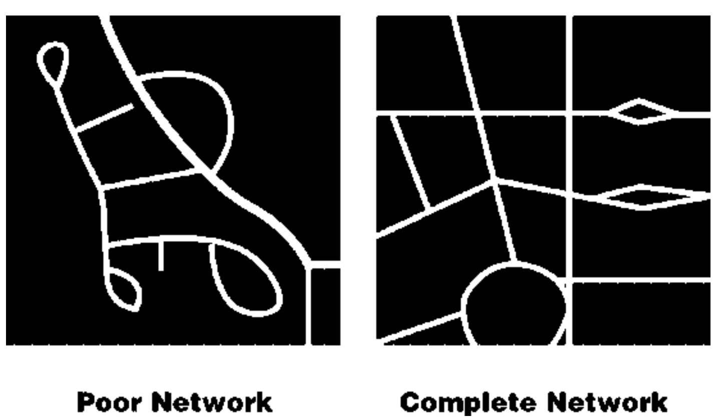


FIGURE 2 Complexity of path network.

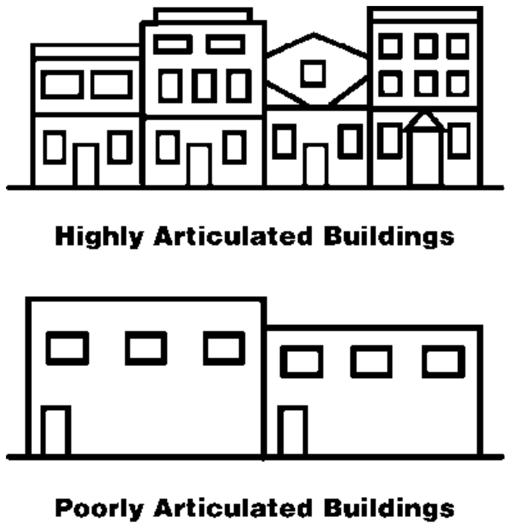


FIGURE 3 Building articulation.

Pedestrians along such routes are forced to view corridor elements at a slow pedestrian pace rather than at their intended "read speed" of 35 to 50 mph, which makes for a very monotonous and unchanging walk. Additionally, strip mall businesses typically rely on aggressive signage and ample parking—as opposed to architectural detail—to attract the attention of passersby. Figure 3 diagrammatically compares well-articulated and poorly articulated groups of buildings.

Complexity of Spaces

Frequent variation in the orientation and character of public spaces adds to the general level of interest of commercial districts and residential neighborhoods. Such spaces include courtyards, plazas, parks, and playgrounds. Natural elements, such as water features and indigenous trees, can be celebrated within these public spaces to help draw attention to the unique physical qualities of a particular area. The geometrics of public spaces should be such that interesting and rapidly changing views are facilitated.

The presence and variation of public spaces along pedestrian routes ensure that long walks are broken up with occasional sectors of heightened interest. Figure 4 illustrates in

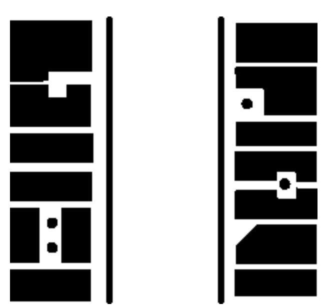


FIGURE 4 Complex spaces.

plan view the manner in which public spaces might be distributed throughout a town center district.

Overhangs/Awnings/Varied Roof Lines

The degree to which items *above* street level contribute to the experience *at* street level, in terms of both aesthetics *and* functionality, is a very important aspect of pedestrian planning.

In terms of appearance, the presence of overhangs, awnings, and varied roof lines enhances the pedestrian experience in the same manner as does the articulation of buildings through diverse materials and décor, contributing variation and aesthetic quality. From a functional perspective, overhangs and awnings contribute to pedestrian comfort by providing shade from sunlight and shelter from rainfall.

In residential neighborhoods, this category of evaluation is not typically applicable, due to larger standard setbacks and wider spaces between buildings as compared with town center commercial districts. In the former, *street trees* often perform many of the functions of overhangs and awnings.

Buffer

The presence of a "buffer zone" between pedestrians and moving vehicles greatly enhances pedestrian safety and comfort. Buffer improves *actual* safety through the placement of solid objects between moving vehicles and people, reducing the likelihood that a collision involving a pedestrian will occur. *Perceived* safety, which is roughly synonymous with pedestrian comfort, is likewise increased as the buffer zone is enlarged and solidified because pedestrians along the improved corridor would *feel* as if their chances of becoming involved in a collision have been lowered.

Minimal buffers entail narrow landscaped strips intended merely to provide spacing between the sidewalk and the roadway. The addition of large street trees to landscaped strips exponentially increases their value as buffers. In busy commercial districts, buffer is often facilitated by parallel or diagonal on-street parking which, given sufficiently high occupancy rates, serves as a continuous solid barrier between pedestrians and fast-moving vehicles.

Figure 5 contains a pair of diagrams depicting a well-buffered street in comparison to a poorly buffered street. The former contains a "buffer lane" between the sidewalk and travel lanes consisting of extensive landscaping or parallel parking, or some intermittent combination of both. The latter illustration does not contain such a zone, and instead places sidewalks flush up against moving traffic lanes. The vertical elements outside the sidewalks, in both pictures, represent the sidewalk-fronting structures of a well-enclosed street.

Shade Trees

The presence of shade trees improves the comfort level of pedestrians on hot summer days. Shade trees are effective at keeping pedestrians cool as well as blocking the sun from their eyes. Additionally, shade trees add a nice aesthetic element to the street and contribute to definition and buffer. In some cases, street trees also provide shelter from rain (but not during lightning storms, of course).

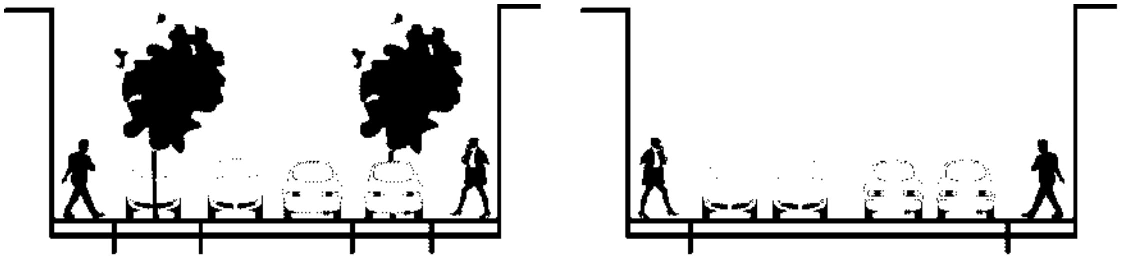


FIGURE 5 Buffer.

Transparency

Transparency addresses the transition between the public space and private space. In business areas, transparency is created through the use of windows, outdoor displays, and sidewalk cafes. In residential areas, front porches facilitate a smooth interface between the public street and private house.

Such transitional elements bring the public and private realms within clear view of one another, allowing passing pedestrians to get a feel for the private space without having to enter each individual building. Structures that greet the public realm with blank, windowless walls or twelve-foot-high fences typically garner low scores for transparency.

Physical Components/Condition

This category of evaluation addresses the specific physical qualities of the sidewalk and its surroundings that are not explicitly covered by any of the other eight evaluation measures. As described below, *physical components/condition* addresses both the structural integrity and functionality of the sidewalk and the overall contribution (positive or negative) of other physical elements in the corridor, such as the street itself.

Sidewalk Configuration and Condition

For obvious reasons, the overall physical condition of sidewalks and streets profoundly impacts the quality of the pedestrian environment. Areas containing no sidewalks at all typically receive the lowest possible ratings in this category, except in the rare cases where streets themselves are designed to serve as safe, shared travelways. Low ratings are also assigned to areas with broken or cracked sidewalks, disproportionately narrow sidewalks, sidewalks having trees or poles obstructing the walking path, or sidewalks that collect and retain unreasonably high volumes of standing water during rainstorms.

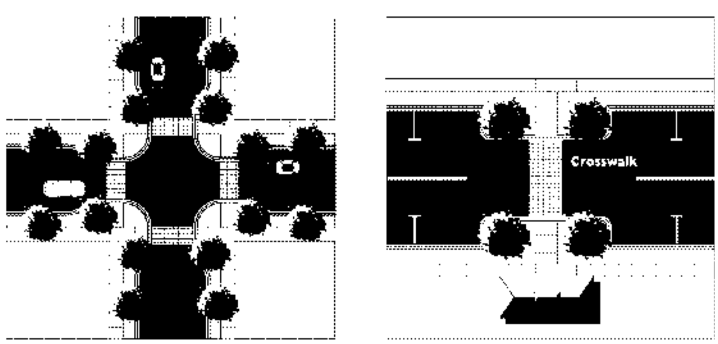
Vehicular Speed

As previously mentioned, vehicular speed greatly affects the actual and perceived safety of pedestrians along a roadway. Speed is influenced by many factors, the least of which is probably the posted speed limit. Although *enclosure*, as facilitated by buildings and street trees, has a great deal of influence over driver speed, so does the physical design of the roadway itself.

Roadway *design* speed, not *posted* speed, is the most influential factor in determining roadway operating speed. In general, the following factors encourage slow speeds and hence serve as positive influences on the overall pedestrian environment:

1. *Narrow lane widths*, i.e., 10- to 11-foot lanes as opposed to 12- to 14-foot lanes.
2. *Narrow overall paved widths*. In general, two-lane roadways are more pedestrian-friendly than six-lane roadways, though careful attention to design can largely offset this inherent disadvantage of high-volume thoroughfares. The effect of a bicycle lane is largely negligible, since it adds to overall paved width but at the same time provides additional separation (buffer) between pedestrians and automobiles.
3. *Broken sight lines*. The longer the unimpeded view down the roadway, the faster the motorist will feel comfortable driving. Such a view can be broken up through the placement of in-street traffic calming devices such as roundabouts and splitter islands, or by designing the roadway to meander slightly back and forth along its length.
4. *Sharp turns*. Smoothly curving roadways and large corner radii allow vehicles to navigate comfortably at high-speeds, while jagged, “kinked” roadways and small corner radii require motorists to drive slowly to perform turning maneuvers, giving them more time to see and react to pedestrians and bicyclists.
5. *On-street parking*. In addition to contributing to an overall sense of enclosure and narrowness, on-street parallel or diagonal parking increases motorists’ overall levels of alertness, requiring them to be constantly aware of the surrounding parked vehicles. This increased wariness improves the chances that motorists will notice pedestrians who attempt to cross the street.
6. *Treatment at pedestrian crossings.* Special treatment at pedestrian crossings, such as bulb-outs and textured paving, can encourage motorists to drive with caution by increasing their awareness that pedestrians might be present. Raised crosswalks and speed bumps are often not desirable because they frustrate and anger motorists and hence increase the likelihood that they will drive unintelligently.

Figure 6 illustrates the value of bulb-outs with respect to the preceding principles. Specific elements of the following diagrams include narrowed lanes, textured paving at



Intersection bulb-outs with textured crosswalks

Mid-block bulb-outs with textured crosswalk

FIGURE 6 Bulb-out treatments.

crosswalks, and tight turn radii, all of which encourage motorists to slow down while increasing their awareness that pedestrians might be nearby.

Lighting

The level of lighting along the street also has considerable implications for pedestrian safety—in terms of both *criminal activity* and *protection from vehicles*.

The Illuminating Engineering Society of North America (IES) specifies lighting standards for sidewalks along various types of roadways to protect pedestrians from motorists who otherwise might not see them. The IES standards are intended to ensure that a certain minimum of illumination is maintained along pedestrian corridors beneath and between light poles (IES 1993).

These minimum illumination levels can be obtained with bright, widely spaced, high-mounted lamps or dimmer, closely spaced, low-mounted lamps, the latter of which are usually preferable because of their more consistent contribution to the pedestrian corridor. Lighting standards for residential areas are often lower than those for commercial areas due to their having less background clutter against which pedestrians are difficult to see.

Street lights should be placed such that they discourage crime in addition to guarding against pedestrian/vehicular conflicts. In addition to maintaining minimum IES standards along the corridor, lights should be located so that the number of potential “hiding places” along the corridor—unlit plazas, parks, alleys, and other dark spaces—are minimized.

APPLICATION IN WINTER PARK, FLORIDA

In the Winter Park Comprehensive Mobility Study, each of the city’s circulation elements—roadways, transit, bicycles, and pedestrians—were analyzed, along with general policy issues, for their overall performance and sustainability. In the study’s *pedestrian circulation evaluation*, neighborhoods and commercial thoroughfares were examined for compliance with the nine evaluation measures described above. Along with public input, these measures helped identify not only the *areas* requiring improvement, but also the exact enhancements needed at specific locations.

Winter Park is a first-rung suburb of Orlando that developed as an independent community at the turn of the century. Its town center is very traditional in nature and economically very vibrant, while several of its staple residential neighborhoods were developed before the era of widespread automobile use and hence represent fantastic examples of pedestrian-oriented design. Nonetheless, the traffic demands of a rapidly suburbanizing region have taken their toll on several parts of Winter Park, sacrificing many of the qualities that once established the city as one of the premiere communities in Central Florida. Winter Park, hence, provides excellent examples of both very good and very bad pedestrian conditions.

Figure 7 is a map of the city, with the traditional town center appearing as the dark gray area near the middle (directly north of Rollins College). This map was utilized as the geographical key to the mobility study’s pedestrian evaluation.

The city’s residential neighborhoods are shown in the diagram as light gray, with names such as Osceola, Genius, and Mead Gardens. In the pedestrian evaluation, these

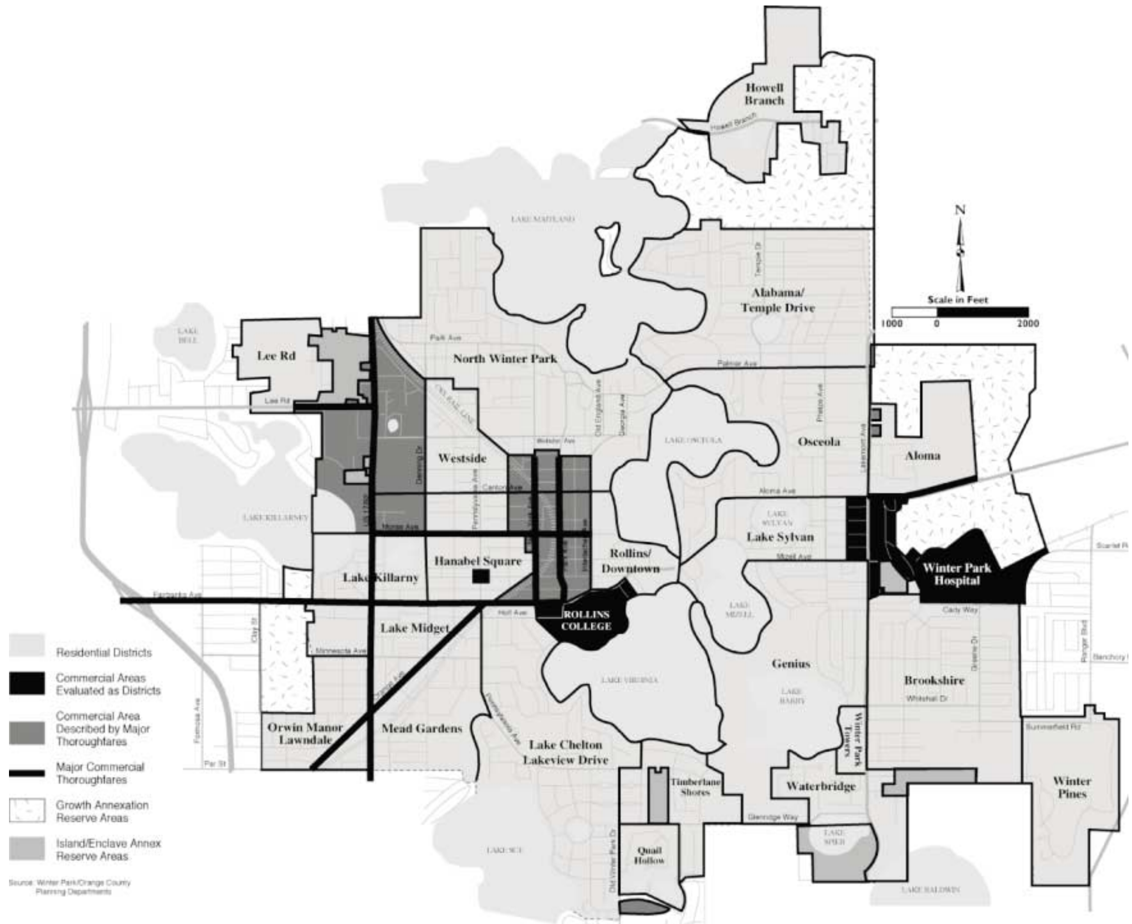


FIGURE 7 Map of Winter Park, Florida.

neighborhoods were analyzed as single whole districts, due to the fact that each of their component streets retains a generally consistent neighborhood character.

The *Winter Park Hospital* and *Rollins College* commercial areas, likewise, were evaluated as entire districts because of the general consistency of their roadways. Conversely, the remaining two of the city's commercial areas—the town center district plus a strip mall area roughly centered along US 17/92 to the west—contain several very diverse thoroughfares within their borders and hence were not analyzed as single entities. In these cases—labeled "commercial areas described by major thoroughfares"—each of the major component roadways of the two districts was evaluated on an individual basis.

A few excerpts from the pedestrian evaluation of Winter Park are included and described below to illustrate the progression of the overall process. The final specific recommendations were based upon the evaluation matrices explained below, which were filled out through site investigation, and upon the various ideas for improvement generated at numerous public workshops.

Site Evaluation Matrices

Figure 8 is one of three evaluation matrices compiled in the early stages of the mobility study. Figure 8 analyzes the city's commercial corridors and districts, while the remaining

Principles of Pedestrianization	Lee Road	Orlando Avenue	Morse west of Park	Morse east of Park	Fairbanks Avenue	Orange Avenue	New York Avenue	Park Avenue	Aloma Avenue	Rollins College	Winter Park Hospital	Hannibal Square
enclosure/definition	1	1	2	5	2	2	3	4	1	4	1	3
complex spaces	1	1	2	3	1	1	1	5	1	5	2	1
highly articulated buildings	1	1	3	5	2	2	2	4	2	5	2	3
overhangs/awnings	1	1	1	5	3	3	1	4	1	2	1	3
complex path network	1	1	3	5	2	2	4	5	1	5	3	3
buffer	1	1	1	5	1	3	1	4	2	4	3	3
shade trees	1	1	1	3	1	1	3	3	1	4	3	1
transparency	2	2	2	4	3	3	2	5	2	3	2	2
physical condition	2	2	2	5	1	4	3	4	4	5	3	4

Key: 5 = excellent; 4 = good; 3 = average; 2 = poor; 1 = very poor.

FIGURE 8 Sample pedestrian LOS evaluation matrix.

two matrices (not shown) examine the city's residential neighborhoods (split into two groups, *eastern* and *western*). Figure 8 lists each of the twelve distinct commercial areas/corridors within Winter Park and catalogues their scores for each of the nine pedestrian evaluation measures. These scores were assigned entirely on the basis of site inspection.

As can be inferred from the scores, Park Avenue and "Morse East of Park" make up the city's core central business district, which was originally designed for pedestrians before the era of widespread automobile use. Rollins College, also a recipient of high scores, has also evidently paid very careful attention to its pedestrian environment over the years, for the probable primary reason that pedestrians constitute a very high proportion of on-campus travelers. The maintenance of a pleasant campus travel environment is critical to the attraction of quality students.

Had the study assigned aggregate pedestrian LOS levels for each of the commercial districts, the scores for Park Avenue, Morse East of Park, and Rollins College would have been 4.2, 4.4, and 4.1, respectively—all within the "very pleasant" category of pedestrian environments as defined earlier.

Conversely, Lee Road (SR 423) and Orlando Avenue (US 17/92) receive extremely poor scores virtually across the board. These two corridors are quintessential fringe suburban highways designed overwhelmingly for automobile travel with a general lack of attention to pedestrian conditions. Nonetheless, under *conventional* pedestrian LOS analyses, Lee Road and Orlando Avenue would have scored very highly, for the reasons that neither of the two roads exhibits a large number of pedestrians and that both contain sidewalks, a combination resulting in uncongested pedestrian flows. However, when qualitative factors, stringent safety considerations, and supporting design characteristics are taken into account in addition to volume and capacity concerns, Lee Road and Orlando Avenue receive very low pedestrian LOSs—1.2 for both roadways according to the methodology proposed in this report, a resounding "very unpleasant."

After the site evaluation matrices were published and discussed at public forums, conclusions were made as to the site-specific pedestrian needs of each of the city's neighborhoods and commercial areas. In the end, most of the deficiencies highlighted by the evaluation tables were carried over to the *recommended pedestrian improvement* tables to be described next.

Recommended Pedestrian Improvements

The *recommended pedestrian improvement* tables document and address specific deficiencies—a large proportion of which were identified in the evaluation matrices—for each of Winter Park's commercial corridors and residential neighborhoods, along with many very site-specific deficiencies noted with particular interest at public workshops. These additional deficiencies were comprised mainly of high-priority safety concerns of area residents, especially in regards to dangerous intersections and crosswalks. In all, the recommendation tables were based upon a comprehensive evaluation that identified deficiencies ranging from the very site-specific to those that were broader-based and long-term.

Thus, the tables were designed to address both short-term, high-priority physical needs *and* long-term policies aimed at preserving and enhancing the city's reputation as a desirable and safe place to live. These deficiencies are listed in the first column of the sample recommendation tables in Figures 9 and 10.

The second column identifies short-term physical improvements corresponding directly to the deficiencies in the first column. Proposed improvements shown in bold italics represent actions identified as high priority or as relatively easy to implement.

The third and final column identifies long-term design/policy initiatives that support the overall principles of improved pedestrianization. These items consist of design regulations, long-term development and transportation strategies, and ideas for complementary public investment.

The supporting sketches included with the tables were generated in response to the public workshops held to obtain citizen comment. The pair of illustrations included with Figure 9 shows Orange Avenue, a roadway that radiates from Winter

Corridor/District	Specific Problem	Short-Term Physical Improvements	Long-Term Design/Policy Solutions
Orange Avenue	Dangerous pedestrian crossing at intersection with Orlando Avenue	Add distinguishable, possibly textured, cross-walks as pedestrian activity increases with Harmon Avenue light rail station	Enact strict design regulations that set the stage for pedestrian oriented station area development
	Lack of enclosure, shade, and effective buffer	***Bulb-outs with large shade trees between every 3 or 4 parking spaces***	Encourage 2-3-story development (which is consistent with street width)

Existing Orange Avenue

Proposed Orange Avenue

FIGURE 9 Sample recommendation table with supporting illustrations.

Corridor/District	Specific Problem	Short-Term Physical Improvements	Long-Term Design/Policy Solutions
Lake Killarney	Lack of shade	Install shade trees	
	No sidewalk fronting lake	Install sidewalk between Killarney Drive and the lake	Coordinate with traffic calming (brick paving) on Killarney Drive
Lake Midget	Denning Drive wider than necessary for given traffic volumes	Convert unnecessary roadway space to pedestrian and bicycle amenities	
Lake Sylvan	Few sidewalks	Install sidewalks	
Lee Road	Lack of sidewalks, enclosure, and shade	Install sidewalks and street trees	
Mead Gardens	Lack of sidewalks, enclosure, and shade	Install sidewalks and street trees	
	High-speed traffic and no sidewalks on Garden and Orchid	***Install 5-foot sidewalks and 8-10-foot buffers consisting of large street trees like those at Gardens entrance***	
	Dangerous intersections at Harmon-Denning, Garden-Denning, Garden-Orchid, and Camelia-Orchid	***Install distinguishable, possibly textured, crosswalks and employ "bulb-out" design to bring corners closer together***	Coordinate with traffic calming program where improvements overlap
	Dangerous stretch of roadway along Barnum near Denning	***Install sidewalks along Barnum and distinguishable crosswalks at Denning***	Coordinate with traffic-calming program where improvements overlap
	No direct pedestrian connection to Harmon Avenue light rail station site	Install pedestrian- and bicycle-only connection via Harmon right-of-way	Coordinate with light rail program

Existing Orchid Avenue

Proposed Orchid Avenue

FIGURE 10 Sample recommendation table with supporting illustrations.

Park's historic town center and which suffers from a general lack of enclosure and shade. The existing parallel parking lane on Orange Avenue, as can be seen in the photo, does not often achieve the critical occupancy rates required to serve as an effective buffer. The accompanying sketch illustrates the merits of planting shade trees *across the parallel parking lane* between every three or four parking stalls—narrowing the perception of the street to motorists and adding a permanent element to the buffer zone. The sketch also indicates the manner in which additional street trees and two- to three-story structures can further enhance shade, buffer, and enclosure along the corridor.

Figure 10 is an excerpt from the recommendation table for Winter Park's residential neighborhoods, with supporting illustrations for the Mead Gardens district. The conceptual sketch indicates how the addition of sidewalks and street trees can modify the overall character of Mead Gardens' Orchid Avenue, contributing narrowness, buffer, and shade.

CONCLUSION

As expressed in the *Winter Park Comprehensive Mobility Study*, pedestrian level-of-service entails much more than volumes and capacities. In order to encourage walking as a viable alternate form of transportation, it is essential that careful attention be paid to pedestrian comfort and safety in addition to traditional volume and capacity factors. The nine evaluation measures proposed in this paper identify and classify the qualities that contribute to positive pedestrian experiences. The use of these nine measures in pedestrian analyses can help generate a list of specific needed improvements at precise locations throughout a study area.

ACKNOWLEDGMENTS

Many thanks to the numerous personnel from Glatting Jackson, Dover Kohl & Partners, and the City of Winter Park who were involved in the refinement and graphical presentation of this concept through their participation in the *Winter Park Comprehensive Mobility Study*.

BIBLIOGRAPHY

Illuminating Engineering Society of North America (IES). *Lighting Handbook, 8th Edition*, 1993.

Jacobs, Allan B. *Great Streets*. Boston: MIT, 1993.

Rapoport, Amos. *History and Precedent in Environmental Design*. New York: Plenum, 1990.

Special Report 209: Highway Capacity Manual (1994 update). Chapter 13. TRB, National Research Council, Washington, D.C., 1994.

Winter Park Comprehensive Mobility Study. 1998.