Eight Qualities of Pedestrian- and Transit-Oriented Design

By Reid Ewing
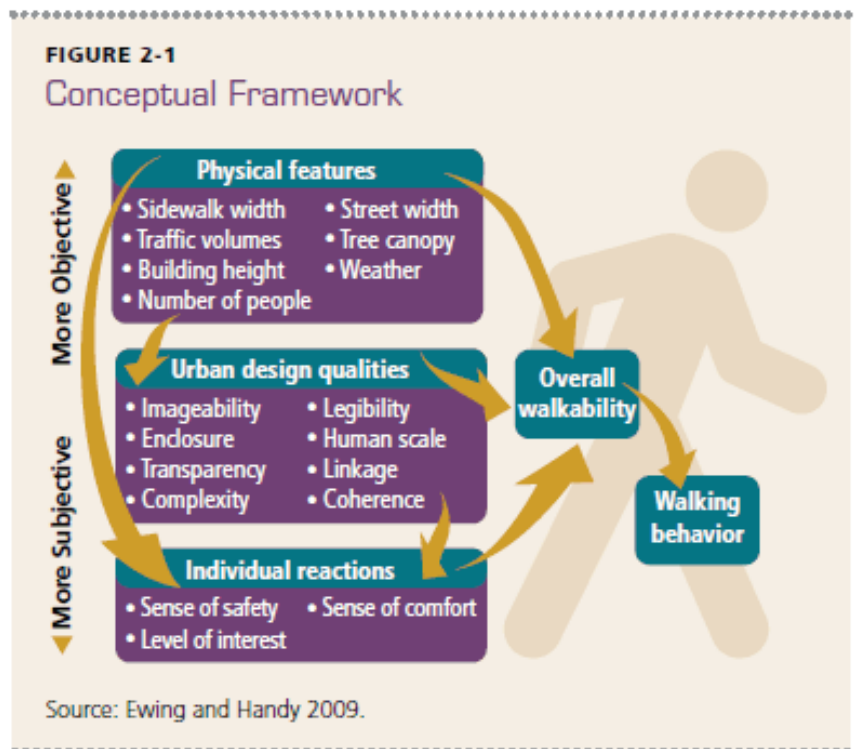
This is an excerpt of the book "Pedestrian- & Transit-Oriented Design," co-authored by Reid Ewing, renowned urban planning expert and University of Utah research professor, and Keith Bartholomew, professor and associate dean of the College of Architecture and Planning at the University of Utah. The book operationalizes nearly a half-century of urban design theory in ways that provide practical meaning and use to urban planners, planning commissioners, city council members, developers, and citizens who desire more livable environments.

Since 2000, a number of tools for measuring the quality of the walking environment have emerged. Generically called walking audit instruments, these tools are now used by researchers, local governments, and community groups to measure physical features related to walkability, such as building setback, block length, and street and sidewalk width. The Robert Wood Johnson Foundation's Active Living Research website alone hosts 16 such instruments (http://www.activelivingresearch.org/).

Yet individual physical features may not tell us much about the experience of walking down a particular street. Specifically, they may not capture people's overall perceptions of the street environment, perceptions that may have complex or subtle relationships to physical features. The urban design literature points to numerous perceptual qualities that may affect the walking experience. Other fields also contribute, including architecture, landscape architecture, park planning, environmental psychology, and the growing visual preference and visual assessment literature.

Perceptual or urban design qualities are linked to walking behavior through the conceptual framework shown in figure 2-1 (right). Perceptions intervene (or mediate) between the physical features of the environment and walking behavior. Physical features influence the quality of the walking environment both directly and indirectly through the perceptions and sensitivities of individuals.

Urban design qualities are different from such qualities as sense of comfort, sense of safety, and level of interest that reflect how individuals react to a place—how they assess the conditions there, given

FIGURE 2-1
Conceptual Framework

More Objective / More Subjective

Physical features
- Sidewalk width
- Street width
- Traffic volumes
- Tree canopy
- Building height
- Weather
- Number of people

Urban design qualities
- Imageability
- Legibility
- Enclosure
- Human scale
- Transparency
- Linkage
- Complexity
- Coherence

Individual reactions
- Sense of safety
- Sense of comfort
- Level of interest

Overall walkability

Walking behavior

Source: Ewing and Handy 2009.

their own attitudes and preferences. Perceptions may produce different reactions in different people. They can be assessed with a degree of objectivity by outside observers; individual reactions cannot.

A literature review yielded a list of 51 perceptual qualities of the urban environment. Of the 51, eight were selected for further study based on the importance assigned to them in the literature: (1) imageability, (2) enclosure, (3) human scale, (4) transparency, (5) complexity, (6) coherence, (7) legibility, and (8) linkage. Of the eight, the first five were successfully measured in a manner that met tests of validity and reliability.

The approach was to link specific physical features to urban design quality ratings by a panel of experts for a sample of street scenes that had been videotaped. The panel members helped define urban design qualities of streetscapes, rated different scenes with respect to those qualities, and submitted to interviews as they assigned their ratings to provide the research team with qualitative insights into the physical features that influenced their ratings.

The following sections explain the eight urban design qualities that were operationalized by the expert panel, providing the literature relevant to each quality and outlining the qualitative responses from panel members. Appendix B includes a list of panel members and their quantitative assessments. (The appendices are available at http://content.lib.utah.edu/cdm/ref/collection/uspace/id/6133.)

(Pictured: Westwood Village, California)
Photo: Dan Burden

Imageability

Imageability is the quality of a place that makes it distinct, recognizable, and memorable. A place has high imageability when specific physical elements and their arrangement capture attention, evoke feelings, and create a lasting impression. According to Kevin Lynch (1960), a highly imageable city is well formed, contains distinct parts, and is instantly recognizable to anyone who has visited or lived there. It plays to the innate human ability to see and remember patterns. It is a city whose elements are easily identifiable and grouped into an overall pattern.

Landmarks are a component of imageability. The term landmark does not necessarily denote a grandiose civic structure or even a large object. In Lynch's words, it can be "a doorknob or a dome." What is essential is its singularity and location, in relationship to its context and the city at large. Landmarks are a principle of urban design because they act as visual termination points, orientation points, and points of contrast in the urban setting. Tunnard and Pushkarev (1963, p. 140) attribute even greater importance to landmarks, saying, "A landmark lifts a considerable area around itself out of anonymity, giving it identity and visual structure."

Imageability is related to "sense of place." Gorden Cullen (1961, p. 152) elaborates on the concept of sense of place, asserting that a characteristic visual theme will contribute to a cohesive sense of place and will inspire people to enter and rest in the space. Jan Gehl (1987, p. 183) explains this

phenomenon using the example of famous Italian city squares, where "life in the space, the climate, and the architectural quality support and complement each other to create an unforgettable total impression." When all factors manage to work together to such pleasing ends, a feeling of physical and psychological well-being results: the feeling that a space is a thoroughly pleasant place in which to be.

Imageability is influenced by many other urban design qualities—enclosure, human scale, transparency, complexity, coherence, legibility, and linkage—and is in some way the net effect of these qualities. Places that rate high on these qualities are likely to rate high on imageability as well—the neighborhoods of Paris or San Francisco, for example. However, places that rate low on these qualities may also evoke strong images, though ones that people may prefer to forget, such as boring industrial parks or strips of faceless shopping centers. Urban designers focus on the strength of positive images in discussing imageability and sense of place. The urban design panel most often mentioned vernacular architecture as a contributor to imageability. Other influences mentioned were landmarks, striking views, unusual topography, and marquee signage.

Enclosure

Enclosure refers to the degree to which streets and other public spaces are visually defined by buildings, walls, trees, and other vertical elements. Spaces where the height of vertical elements is proportionally related to the width of the space between them have a room-like quality.

Outdoor spaces are defined and shaped by vertical elements, which interrupt viewers' lines of sight. A sense of enclosure results when lines of sight are so decisively blocked as to make outdoor spaces seem room-like. Cullen (1961, p. 29) states that "enclosure, or the outdoor room, is, perhaps, the most powerful, the most obvious, of all the devices to instill a sense of position, of identity with the surroundings…. It embodies the idea of here-ness." Alexander, Ishikawa, and Silverstein (1977, p. 106) say that "an outdoor space is positive when it has a distinct and definite shape, as definite as the shape of a room, and when its shape is as important as the shapes of the buildings which surround it." In an urban setting, enclosure is formed by lining the street or plaza with unbroken building fronts of roughly equal height. The buildings become the walls of the outdoor room, the street and sidewalks become the floor, and if the buildings are roughly equal height, the sky projects as an invisible ceiling. Buildings lined up that way are often referred to as street walls. Alexander, Ishikawa, and Silverstein (1977, pp. 489 91) state that the total width of the street, building to building, should not exceed the building heights in order to maintain a comfortable feeling of enclosure. Allan Jacobs (1993) is more lenient in this regard, suggesting that the proportion of building heights to street width should be at least 1:2. Other designers have recommended proportions as high as 3:2 and as low as 1:6.

(Pictured: Madison, Wisconsin)
Trees can help to form a sense of enclosure.
Photo: Dan Burden

At low suburban densities, building masses become less important in defining space, and street trees assume the dominant role. Rows of trees on both sides of a street can humanize the height-to-width ratio. Henry Arnold (1993) explains that trees define space both horizontally and vertically. Horizontally, they do so by visually enclosing or completing an area of open space. Vertically, they define space by creating an airy ceiling of branches and leaves. Unlike the solid enclosure of buildings, tree lines depend on visual suggestion and illusion. Street space will seem enclosed only if trees are closely spaced. Properly scaled, walls and fences can also provide spatial definition in urban and suburban settings.

Visual termination points may also contribute to a sense of enclosure. New urbanists such as Andres Duany advocate closing vistas at street ends with prominent buildings, monuments, fountains, or other architectural elements as a way to achieve enclosure in all directions (Duany and Plater-Zyberk 1992). When the sides of a street are not strongly defined by buildings, focal points at its ends can maintain the visual linearity of the arrangement. Similarly, the layout of the street network can influence the sense of enclosure. A rectilinear grid with continuous streets creates long sight lines that may undermine the sense of enclosure created by the buildings and trees that line the street. Grids with nonorthogonal street connections, however, may create visual termination points that help enclose a space.

Enclosure is eroded by breaks in the continuity of the street wall, that is, breaks in the vertical elements, such as buildings or tree rows that line the street. Breaks in continuity that are occupied by nonactive uses create dead spaces that further erode enclosure; vacant lots, parking lots, driveways, and other uses that do not generate human activity and presence are all considered dead spaces. Large building setbacks are another source of dead space. Alexander, Ishikawa, and Silverstein (1977, p. 593) say, "Building setbacks from the street, originally invented to protect the public welfare by giving every building light and air, have actually helped greatly to destroy the street as social space."

The expert panel suggested that on-street parking, planted medians, and even traffic itself contribute to visual enclosure. They opined that the required building height to enclose street space varies with context, specifically, between a big city and a small town.

(Pictured: Portland, Maine).
Photo: Dan Burden

Human Scale

Human scale refers to a size, texture, and articulation of physical elements that match the size and proportions of humans and, equally important, correspond to the speed at which humans walk. Building details, pavement texture, street trees, and street furniture are all physical elements contributing to human scale.

The urban design glossary for the city of Seattle (2005, 2007) defines human scale as "the quality of a building that includes structural or architectural components of size and proportions that relate to the human form and/or that exhibits through its structural or architectural components the human functions contained

within" (par. 57). Moderate-sized buildings, narrow streets, and small spaces create an intimate environment; the opposite is true for large buildings, wide streets, and open spaces.

What defines human scale is a matter of opinion. Experts set a range of three stories to six stories. For taller buildings, it has been suggested that lower floors should create a street wall but upper floors should step back before they ascend, giving human-scale definition to the street level but allowing for sunlight. Large buildings should make use of architectural detailing to help mitigate their large scale. For human scale, building widths should not be out of proportion with building heights, as are so many buildings in the suburbs. In what was billed as the first of its kind, Stamps (1998) used a visual assessment survey to explore perceptions of architectural mass. The most important determinant was the cross-sectional area of buildings; second was the amount of window area; and third was the amount of facade articulation and partitioning.

Human scale can also be defined by human speed. Jane Holtz Kay (1997) argues that today, far too many things are built to accommodate the bulk and rapid speed of the automobile; we are "designing for 60 mph." When approached by foot, these things overwhelm the senses, creating disorientation. For example, large signs with large lettering are designed to be read by high-speed motorists. For pedestrians, small signs with small lettering that are perpendicular to the building facade are much more comfortable and more effective: large signs that are flush with the facade tend not to be visible by those passing by on the adjacent sidewalk.

Street trees can moderate the scale of tall buildings and wide streets. According to Henry Arnold (1993), where tall buildings or wide streets would intimidate pedestrians, a canopy of leaves and branches allows for a simultaneous experience of the smaller space within the larger volume. He posits that where streets are over 40 feet wide, additional rows of trees are needed to achieve human scale. Hedman (1984) recommends the use of other small-scale elements, such as clock towers, to moderate the scale of buildings and streets.

Jan Gehl (2010) demonstrates how distance plays a determinative role in personal interaction and hence designing for the human scale. At 300 to 500 meters (330-550 yards), humans can identify other people as humans, instead of objects. From 100 to 25 meters (110-27 yards), individual characteristic and body language can be observed. After 25 meters, people enter a "social" field of vision where "richness of detail and communication intensify dramatically meter by meter" (p. 35). Gehl then breaks the distances into four categories:

• Public distance >12 feet

• Social distance 4.5-12 feet

• Personal distance 1.5-4.5 feet

• Intimate distance 0-1.5 feet

According to Alexander, Ishikawa, and Silverstein (1977), a person's face is just recognizable at 70 feet, a loud voice can just be heard at 70 feet, and a person's face is recognizable in portrait-like detail up to about 48 feet. These distances set the limits of human scale for social interaction and, by extension, how space is designed. Gehl notes that the most noted public squares in Europe are almost all smaller than 10,000 square meters (100 m ×100 m); most are smaller than 8,000 square meters.

In addition to the above elements, the expert panel related human scale to the intricacy of paving patterns, amount of street furniture, depth of setbacks on tall buildings, presence of parked cars, ornamentation of buildings, and spacing of windows and doors. Interestingly, high-rise Rockefeller Center and Times Square in New York City were both perceived as human scaled owing to compensating design elements at street level.

(Pictured: Seattle, Washington).
Credit for b: Eagle Rock Ventures, L.L.C.

Transparency

Transparency refers to the degree to which people can see or perceive what lies beyond the edge of a street or other public space and, more specifically, the degree to which people can see or perceive human activity beyond the edge of a street or other public space. Physical elements that influence transparency include walls, windows, doors, fences, landscaping, and openings into midblock spaces.

Taken literally, transparency is a material condition that is pervious to light or air, an inherent quality of substance as in a glass wall. A classic example of transparency is a shopping street with display windows that invite passersby to look in and then go in to shop. Blank walls and reflective glass buildings are classic examples of design elements that destroy transparency.

But transparency can be subtler than that. What lies behind the street edge need only be imagined, not actually seen. Allan Jacobs (1993) says that streets with many entryways contribute to the perception of human activity beyond the street, whereas those with blank walls and garages suggest that people are far away. Even blank walls may exhibit some transparency if overhung by trees or bushes, providing signs of habitation. Arnold (1993) tells us that trees with high canopies create "partially transparent tents," affording awareness of the space beyond while still conferring a sense of enclosure. By contrast, he notes that small trees in most urban settings work against transparency.

Transparency is most critical at the street level, because that is where the greatest interaction occurs between indoors and outdoors. Whyte (1988) suggests that if a blank wall index were ever computed, as the percentage of blockfront up to a 35-foot height, it would show that blank walls have become the dominant feature of cityscapes. The ultimate in transparency is when internal activities are externalized or brought out to the sidewalk (Llewelyn–Davies 2000). Outdoor dining and outdoor merchandising are examples.

The expert panel suggested that courtyards, signs, and buildings that convey specific uses (for example, schools and churches) add to transparency. Reflective glass, arcades, and large building setbacks were thought to detract from transparency. Interior lighting, shadows, and reflections were also thought to have a role in the perception of transparency.

Complexity

Complexity refers to the visual richness of a place. The complexity of a place depends on the variety of the physical environment, specifically the number and kinds of buildings, architectural diversity and ornamentation, landscape elements, street furniture, signage, and human activity.

Amos Rapoport (1990) explains the fundamental properties of complexity. Complexity is related to the number of noticeable differences to which a viewer is exposed per unit of time. People are most comfortable receiving information at perceivable rates. Too little information results in sensory deprivation; too much creates sensory overload. Similar to Kay's observations regarding human scale, Rapoport contrasts the

complexity requirements of pedestrians and motorists. Slow-moving pedestrians require a high level of complexity to hold their interest, whereas fast-moving motorists will find the same environment chaotic. The suburban commercial strip is too complex and chaotic at driving speeds; yet because of its auto-oriented scale, it yields few noticeable differences at pedestrian speeds.

The environment can provide low levels of usable information in three ways: (1) elements may be too few or too similar; (2) elements, though numerous and varied, may be too predictable for surprise or novelty; or (3) elements, though numerous and varied, may be too unordered for comprehension. Pedestrians are apt to prefer streets high in complexity, since they provide interesting things to look at: building details, signs, people, surfaces, changing light patterns and movement, and signs of habitation. In Life between Buildings, Jan Gehl (1987, p. 143) notes that an interesting walking network will have the "psychological effect of making the walking distance seem shorter," by virtue that the trip is "divided naturally, into manageable stages." This effect helps explain why people will walk longer distances in urban settings than suburban ones.

(Pictured: Boulder, Colorado).
Photo: Adrienne Schmitz

Complexity results from varying building shapes, sizes, materials, colors, architecture, and ornamentation. According to Jacobs and Appleyard (1987), narrow buildings in varying arrangements add to complexity, whereas wide buildings subtract. Allan Jacobs (1993) refers to the need for many different surfaces over which light is constantly moving in order to keep eyes engaged. Tony Nelessen (1994, p. 224) asserts, "If a particular building or up to three buildings are merely repeated, the result will be boring and mass produced." Some variation can be incorporated into the building orientation plan or building setback line to allow for a varied building frontage instead of a monotonous, straight building facade. Too much setback variation, however, can undermine the sense of enclosure provided by a consistent street wall. Numerous doors and windows also produce complexity, as well as a degree of transparency.

Complexity is one perceptual quality that has been measured extensively in visual assessment studies. It has been related to changes in the textures, widths, heights, and setbacks of buildings (Elshestaway 1997), as well as to building shapes, articulation, and ornamentation (Heath, Smith, and Lim 2000; Stamps 1999b).

Other elements of the built environment also contribute to complexity. According to Henry Arnold (1993), one function of trees is to restore the rich textural detail missing from modern architecture. Light filtered through trees gives life to space. Manipulation of light and shade transforms stone, asphalt, and concrete into tapestries of sunlight and shadow. Street furniture also contributes to the complexity of street scenes. Allan Jacobs (1993) states that pedestrian-scaled streetlights, fountains, benches, special paving, and even public art combine to make regal, special places.

Signage is a major source of complexity in urban and suburban areas. If well done, signs can add visual interest, make public spaces more inviting, and help create a sense of place. Cullen (1961, p. 151) calls advertisement signs "the most characteristic, and, potentially, the most valuable, contribution of the twentieth century to urban scenery." When those signs are lit up at night, the result can be spectacular. However, signage must not be allowed to become chaotic and unfriendly to pedestrian traffic. Nasar (1987) reports that people prefer signage with moderate rather than high complexity—measured by the amount of variation

among signs in location, shape, color, direction, and lettering style. Allan Jacobs (1993) uses Hong Kong signage as an example of complexity to the point of chaos.

The presence and activity of people add greatly to the complexity of a scene. They do so not only because people appear as discrete "objects" but because they are in constant motion. Gehl (1987, p. 25) explains that "people are attracted to other people. They gather with and move about with others and seek to place themselves near others. New activities begin in the vicinity of events that are already in progress." In the course of his worldwide travels, Allan Jacobs (1993) found that the most popular streets were those that contained sidewalks fairly cluttered with humans and life, calling them attractive obstacle courses that never failed to entertain.

Complexity can also arise at a larger scale from the pattern of development. Integration of land uses, housing types, activities, transportation modes, and people creates diversity, which in turn adds to complexity (Gehl 1987). Jane Jacobs (1961, p. 161) describes diversity as a mixture of commercial, residential, and civic uses in proximity to one another, creating human traffic throughout the day and night, and subsequently benefiting the safety, economic functioning, and appeal of a place.

The expert panel related complexity to

• layering of built elements at the edge of streets, from sidewalk to arcade to courtyard to building;

• diversity of building ages;

• diversity of social settings; and

• diversity of uses over the course of a day.

Two panel members lamented the loss of complexity as design becomes more controlled and predictable (as in some modern developments under unified ownership).
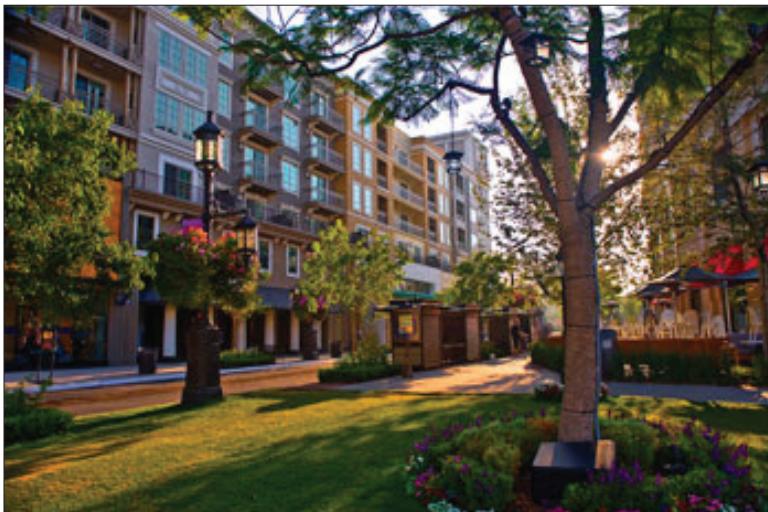
Coherence (Glendale, California).
Photo: Devon Meade & Ian Douglass

Coherence

Coherence refers to a sense of visual order. The degree of coherence is influenced by consistency and complementarity in the scale, character, and arrangement of buildings, landscaping, street furniture, paving materials, and other physical elements.

Allan Jacobs (1993, p. 287) describes coherence in architecture as follows: "Buildings on the best streets will get along with each other. They are not the same, but they express respect for one another, most particularly in respect to height and the way they look." According to Arnold (1993), complexity of architecture of earlier eras was given coherence by common materials, handcrafted details, and reflections of human use. When those elements are absent from architecture, landscaping becomes critical for creating a sense of visual unity; shade trees planted close together result in an uninterrupted pattern of light and shade, unifying a scene. At the city level, coherence takes the form of orderly density patterns and hierarchies of communal spaces (Alexan-

der, Ishikawa, and Silverstein 1977). Nikos Salingaros (2000), applying mathematical principles to the urban setting, concludes, "Geometrical coherence is an identifiable quality that ties the city together through form, and is an essential prerequisite for the vitality of the urban fabric" (par. 4).

It is important to strike a balance between uniformity and idiosyncratic design. Hedman (1984, p. 29) warns that when every building seeks to be a unique statement and the center of attention, there is an unexpected effect: "Instead of providing an exciting counterpoint, the addition of each new and different building intensifies the impression of a nervous, irritating confusion." He lists multiple features of buildings that, when repeated, can create visual unity: building silhouettes, spacing between buildings, setbacks from street, proportions of windows/bays/doorways, massing of building form, location of entryways, surface material and finish, shadow patterns, building scale, style of architecture, and landscaping.

Although often presented as opposites, coherence and complexity represent distinct perceptual dimensions. Visual preference surveys show that viewers do not appreciate massive doses of unstructured information. People like complexity, but not the unstructured complexity of the commercial strip. Scenes with high complexity and low coherence tend to be least liked. In one such survey, Nasar (1987) found that people preferred signage that is moderately complex and highly coherent. Summarizing the results of many surveys, Kaplan and Kaplan (1989, p. 54) deem scenes of low complexity and high coherence as "boring," scenes of high complexity and low coherence as "messy," but scenes of high complexity and high coherence as "rich and organized." It is important to note that coherence does not imply mindless repetition or blandness, rather continuity of design and thematic ordering.

The expert panel described coherence in relation to repeated elements: common building masses, building setbacks, street furniture, and landscaping. They emphasized that there could be ordered diversity and that without diversity, coherent design becomes monotonous.

Legibility

Legibility refers to the ease with which the spatial structure of a place can be understood and navigated as a whole. The legibility of a place is improved by a street or pedestrian network that provides travelers with a sense of orientation and relative location and by physical elements that serve as reference points.

As described by Kevin Lynch (1960, p. 3) in his classic, The Image of the City, legibility is the apparent clarity of the cityscape, the "ease by which its parts can be recognized and can be organized into a coherent pattern." Lynch suggests that when faced with a new place, people automatically create a mental map that divides the city into paths, edges, districts, nodes, and landmarks. Places with strong edges, distinct landmarks, and busy nodes allow people to form detailed and relatively accurate mental maps. Conversely, a city that has no definite edges, nodes, or visually interesting features will be difficult to make sense of and to remember. Legibility facilitates wayfinding—the process by which people move successfully through the physical environment to reach a desired destina-

(Pictured: San Francisco, California).
Photo:Dan Burden

tion—which includes determining a route between two points, choosing an alternate route when the primary route is impassable, navigating along a route, and learning a new spatial environment.

The layout of the street network has an important influence on legibility, although the influence is sometimes ambiguous. A regular grid of streets makes it easy for people to navigate even when they are unfamiliar with a place, although it does not provide a way of distinguishing one block from another. An irregular pattern of streets, in which blocks are of irregular length and compass orientation changes from block to block, may increase the difficulty of navigating and learning the network, although it distinguishes each block with different lengths and orientations. The street network thus works together with other elements of the physical environment to determine the legibility of a place. Signage, in particular, helps distinguish one point from another and to orient and direct a traveler through the network. Landmarks, which have an important influence on imageability, also play an important role in mental maps and thus help increase the legibility of a place.

Visual termination and deflection points also contribute to legibility. Visual termination creates a focal point. New urbanists Andres Duany and Elizabeth Plater-Zyberk (1992) say that visual terminations focus the community, as well as provide a degree of enclosure. On a large scale, visual termination points can include large civic buildings, prominent landmarks, or elements of nature. On a smaller, neighborhood scale, visual termination can be created by using small-scale elements, such as gazebos, landscaped traffic circles, or bends in the roads. Allan Jacobs (1993, p. 297) says of streets, "Since they have to start and stop somewhere, these points should be well marked." He argues that clearly marked end points both serve as reference points and give a sense of definition to an area.

Individual members of the expert panel defined legibility differently, some positing that legibility had more to do with the context of a street than the design of the street itself, and others positing the opposite.

Linkage

Linkage refers to physical and visual connections—from building to street, building to building, space to space, or one side of the street to the other—that tend to unify disparate elements. Tree lines, building projections, and marked crossings all create linkage. Linkage can occur longitudinally along a street or laterally across a street.

Linkages can be defined as features that promote the interconnectedness of different places and that provide convenient access between them. Linkage is closely associated with the concept of connectivity, as both are concerned with the ease of movement in an area and depend on the relationships between paths and nodes. Allan Jacobs (1993) recommends urban intersections every 300 feet or fewer. Alexander Ishikawa, and Silverstein (1977) give similar advice, suggesting pedestrian road crossings every 200 or 300 feet.

They advocate the use of a separate pedestrian-only network running orthogonally to the street grid to maximize pedestrian accessibility. Duany and Plater-Zyberk (1992) generally limit the size of blocks to 230 by 600 feet to ensure reasonable travel distances. On the other hand, Appleyard (1981) argues against too much connectivity through residential areas since through-traffic can erode a sense of community; he suggests breaking up the gridiron with barriers and diverters that impede vehicles but allow for bicycle and pedestrian movement.

Linkages between the street and surrounding buildings are also important and may be psychological as well as physical. Maintenance of sight lines and sidewalk connections are obvious ways to provide this kind of linkage, but it can also be provided in more subtle ways. For example, Arnold (1993) advocates the use

of trees for linkage: continuous tree rows can psychologically connect places at either end, and tree patterns that reflect or amplify building geometry can psychologically link buildings to the street. As Trancik (1986, p. 106) puts it, "Urban design is concerned with the question of making comprehensible links between discrete things."

As with legibility, members of the expert panel had difficulty defining linkage and had low inter-rater reliability in their ratings of street scenes. Linkage was mostly defined by the connectedness of things, and a grid street network was most often used to exemplify the quality of linkage.

(Pictured: Boca Raton, Florida).
Reid Ewing

Conclusion: The preceding sections have introduced eight urban design qualities, along with summaries of the literature behind each quality. These qualities are further illustrated in the checklists and more detailed descriptions in chapters 3 through 5. By considering these qualities, researchers, planners, and policy makers can better understand the relationship between physical features of the street environment and walking behavior and, as a result, they can develop more effective urban design planning solutions for creating quality pedestrian environments.