

DESIGN CODES FOR HEALTHY COMMUNITIES:  
THE POTENTIAL OF FORM-BASED CODES  
TO CREATE WALKABLE URBAN STREETS

By

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A DISSERTATION PRESENTED TO THE GRADUATE SCHOOL  
OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT  
OF THE REQUIREMENTS FOR THE DEGREE OF  
DOCTOR OF PHILOSOPHY

UNIVERSITY OF FLORIDA

2008

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To my husband and my parents, for all their love and support

## ACKNOWLEDGMENTS

Many special people need to be recognized for their help and support. I would like to express my gratitude to all my committee members, especially the chair, Professor Margaret H. Carr, first for encouraging me to pursue a doctoral degree, and second for her constructive critique and steady guidance. Many thanks go to my mentor and committee member, Dr. Joseli Macedo, also for inspiring me to pursue a degree, but mostly for her valuable insight and advice about those seemingly small, but critical items that helped me stay the course. A heartfelt thank-you goes to my outside committee member, Dr. John Spengler, for his guidance on research methodologies and for being a calm and reassuring voice in the midst of confusion. I am also very appreciative of the time and effort of Dr. Charles Hailey and Professor William Tilson for their helpful comments from their perspective on the built environment. And last, but not least, I thank Professor Tina Gurucharri for her time and constructive observations. I found the positive and encouraging attitude of all my committee members to be as valuable as their scholarly advice and comments.

A sincere thank you goes to Professor Robert Grist, chair of the landscape architecture department, for giving me the opportunity to teach a course every semester. I enjoyed working with the students, they are a great inspiration to me, and the teaching assistantships helped immensely with finances. I am also very grateful for the help and friendship of my co-instructors, Professors Kay Williams and Gary Purdum. As always, it was a pleasure to work with them.

I would like to thank all the people who participated in the interview for my study. Their participation was crucial to my study and they were very much appreciated. Also, thanks go to all the planners and city officials who helped me secure the materials and information necessary

for data collection. Their enthusiasm for their work was infectious, and their comments that this study was needed were highly motivating and inspiring.

I would also like to thank staff members who were always helpful, friendly, and pleasant. A special thanks to Cindy Barton who always cheerfully helped with finances and all manner of confusing details, and to Juanita Melchior who helped with the multitude of forms and paperwork. I also greatly appreciate the efforts of the staff members at the Technical Helpdesk for their assistance and friendly nature in those last days of template formatting madness.

And finally, I would like to thank my husband, Frank Chapman, for enthusiastically supporting my goal of obtaining a doctorate degree, and for always being patient and caring.

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Abstract of Dissertation Presented to the Graduate School  
of the University of Florida in Partial Fulfillment of the  
Requirements for the Degree of Doctor of Philosophy

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By

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May 2008

Chair: Margaret H. Carr

Major: Design, Construction, and Planning

Form-Based design codes are a new planning tool being used by communities to create, livable, pedestrian-oriented urban environments. A possible link between physical activity, the built environment, and health has prompted a desire for healthy communities that support physical activity through urban design, including streetscapes that encourage walking as a means of transportation. The application of Form-Based codes are promoted, although not proven, as a means to create walkable streets because they control the street corridor by regulating the physical features of the buildings, sidewalk and street that contribute to the urban design qualities of imageability, complexity, human scale, enclosure, and transparency. These features and qualities were identified as important for walkability in a 2006 study; *Identifying and Measuring Urban Design Qualities Related to Walkability* by Reid Ewing, Susan Handy, Ross Brownson, Otto Clemente, and Emily Winston. The Ewing et al. study developed an audit instrument to measure each design quality and the physical features that define it through their presence on the street. The audit was used to evaluate the Form-Based codes, and it was hypothesized that application of the codes has the potential to create a walkable urban street. Results support the hypothesis; an analysis of 30 Form-Based codes revealed the features

regulated by the codes created the same urban design qualities and features found on historic streets known to be walkable and preferred by users. A survey of streets built by the application of the codes showed the codes have a greater potential to create walkable streets if they regulate a high number of features and control the frequency of the features within a designated length of street. Results also suggest codes are more likely to be successful if the majority of the regulated features are linked to the urban design qualities of imageability, complexity, and human scale. Further study is recommended for several design qualities and environmental features identified, but not validated, in the Ewing et al. study, because results indicate their presence may enhance walkability.

## CHAPTER 1 INTRODUCTION

Have you ever seen Pearl Street in [Boulder] Colorado? Oh, there's a huge park on one side of it. It's a very popular street. I've been there only once, and I remember it very well. It's gorgeous, the architecture. It's very complex, a lot of things going on, as far as the street itself, and the buildings, old architecture, old feel, a big green park. It changes from block to block, retail, older buildings, newer buildings, all of a sudden a big huge open park and water and different level steps, cement and dirt, and grass and everything else, and then again, all retail. Even the retail businesses, I remember a lot of them because it was just beautiful to look at. It was very, very pleasing to the eye, a lot of colors, a lot of different levels to look at. (Interview participant talking about a favorite walking street)

A complex, aesthetically pleasing, pedestrian-friendly urban street is easy to recognize, we know one when we see one. But a high-quality walkable street is not always so easy to define, and even more difficult to codify and design. My study is concerned with the urban design qualities of a walkable street and the use of design codes to create a pedestrian-oriented urban environment. The investigation centers on the design features that are regulated in a typical Form-Based code (FBC) and the potential of the codes to create a walkable urban street. An audit instrument from a recent study of the urban design qualities of walkable streets provided the framework to investigate the code potential and make recommendations for code development. The results of the study suggest that Form-Based codes do have the potential to create walkable urban streets if they regulate a high number of built features that create urban design qualities presumed to be related to walkable streets.

### **Background Information**

Public health officials and community planners are beginning to question the relationship between inactivity, health, and the design of the built environment. Many exercise specialists fear we have engineered physical activity out of our lives with sedentary work and environmental features that discourage physical activity. The lack of a suitable environment in which to be physically active is being investigated as a source of some of society's most

common health problems, particularly obesity and heart disease. The 1999-2000 National Health and Nutrition Examination Survey (NHANES) showed that approximately 31% of the adult population was obese and 15% of children aged 6 to 19 years are overweight, while 60% of children aged 5 to 10 years manifest at least one cardiovascular disease risk factor (Frumkin, Frank, & Jackson, 2004; McCann & Ewing, 2003; Perdue, Stone, & Gostin, 2003).

Exercise specialists advocate increasing lifestyle or utilitarian activity, for example, walking, as the most promising approach to increasing physical activity (Peters, 2004). Of particular interest is the ability to safely and comfortably walk in our communities, and the use of environmental modification to benefit all people exposed to the environment (Boslaugh, Luke, Brownson, Naleid, & Kreuter, 2004; Sallis, Bauman, & Pratt, 1998; Reed, Ainsworth, Wilson, Mixon, & Cook, 2004). The public health goal is to increase regular, moderate-intensity physical activity, mostly by walking in and around local neighborhoods (Reed et al., 2004).

Although the 1996 Surgeon General's report (U.S. Department of Health and Human Services [USDHHS], 1996) cited many studies showing the link between physical activity, and health, no study has shown a direct relationship between health, physical activity and characteristics of the built environment (Frank, Eengelke, & Schmid, 2003; McCann et al., 2003). Studies do suggest, however, that the built environment impacts how and where we walk, and that the overall levels of physical activity are higher in walkable environments (Ewing, Schmid, Killingsworth, Zlot, & Raudenbush, 2003). A study by Frank et al. (2003) showed that in highly walkable neighborhoods people were 35% overweight and averaged 195 minutes/week of moderate physical activity, while people in neighborhoods with poor walking conditions were 60% overweight and averaged 130 minutes/week of moderate physical activity.

In May 2002, the National Center for Environmental Health, Centers for Disease Control and Prevention (NCEHCDC) in Atlanta hosted a workshop to develop a scientific research agenda to study the relationship between the built environment and the physical and mental health of the residents. Experts in the areas of physical activity, urban planning, transportation, architecture, epidemiology, land use, mental health, social capital, housing, and social marketing defined and described 37 questions to be considered for future research. Of primary concern was the effect that the design of communities has on physical activity. Noting that community characteristics, such as proximity to recreation facilities, street design, and housing density, can promote or discourage physical activity, the workshop participants wrote that design choices by planners and policymakers could improve public health in multiple ways. They proposed the following research question: “What model codes (such as the SmartCode) already exist and how can one analyze model codes to assess their impacts on health?” (Dannenberg et al., 2003; p. 1506). The interest in the impact of design codes on health stems primarily from the potential of the codes to create an environment that encourages, rather than discourages, physical activity, particularly the ability to create a community where walking is common for utilitarian purposes.

The emergent research agenda is concerned with the concept of “walkability”, a term used to describe conditions in the built community that encourages walking (Brownson, et al. 2004; Carnegie, et al. 2002; Giles-Corti & Donovan, 2003; Leslie, et al. 2005; Southworth, 2005). “Walkability” is a term that is used frequently, but it is not well defined. Southworth (2005) offered the following definition for clarification, which is adopted for this paper:

Walkability is the extent to which the built environment supports and encourages walking by providing for pedestrian comfort and safety, connecting people with varied destinations within a reasonable amount of time and effort, and offering visual interest in journeys throughout the network. (p. 248)

Neighborhoods are generally considered pedestrian-oriented if they have high densities and mixed land use with a highly connective, human-scale, street network and desirable aesthetic qualities. But the connection of some of these conditions to walkability is based more on intuition rather than empirical testing (Handy, Boarnet, Ewing, & Killingsworth, 2002; Owen, Humpel, Leslie, Bauman, & Sallis, 2004). Other hypothesized characteristics that might encourage walking include sidewalks and street design, such as street width, paving materials, and signage (Brownson et al., 2004; Hoehner et al., 2005; Leslie et al., 2005).

Few studies have evaluated the effects of street level (sidewalks and street) characteristics, and little consensus exists on the relative importance of the aesthetics, such as visual details, landscape features, and spatial relationships on the desirability of places for walking (Hoehner, Ramirez, Elliot, Handy, & Brownson, 2005; Zacharias, 2001). Some of the factors that contribute to aesthetic qualities include varied architecture with small-scale detail, transparency (windows) in the fronting structures, landscaping with street trees, changing vistas, street furniture, and pedestrian lighting--all qualities that contribute to a strong "sense of place" (Handy et al., 2002; Southworth, 2005). The aesthetic characteristics include items that are difficult to assess both qualitatively and quantitatively, and in the past they have typically been described rather than measured (Zacharias, 2001). Research has shown, however, that measurement techniques based on the materials, geometric relationships, location in space, and frequency within a defined area can be used to describe and quantify aesthetic quality (Stamps, 2000; Van der Laan, 1983). Of particular interest from a designer's perspective are questions about how a user's perception of the environment influences walking behavior, especially on issues such as the sensory experience, physical comfort, and the visual and auditory experience (Zacharias, 2001). Environmental psychologists separate the aesthetic qualities into two categories. The first

category is the physical (measurable) qualities that collectively contribute to the second category, which is the experiential (perception and preference) quality (Ataov, 1998; Lang, 1987; Porteous, 1996; Purcell, 1986). Research has shown (a) common architectural perceptions and preferences among the public, and (b) urban design preferences can be described through measurable physical qualities or design features (Ataov, 1998).

The ability to measure physical qualities and user preferences are important concepts for the application of design codes, such as Form-Based codes (FBCs), to the creation of walkable streets. As the name implies, Form-Based codes regulate the form and visual quality of the street through description and measurement of the design features. A primary goal of Form-Based codes is the creation of urban streets that will encourage a high level of pedestrian activity. The codes typically regulate design features that relate to user preferences for public spaces (Katz, 2004).

### **Preconditions and Assumptions**

Although few studies exist on aesthetic quality and the visual experience of the street, a recent study by Ewing, Handy, Brownson, Clemente, and Winston (2006) sought to identify and measure urban design qualities that relate to walkability. A final report was produced by the team of Ewing, Clemente, Handy, Brownson, and Winston (2005) titled: *Identifying and Measuring Urban Design Qualities Related to Walkability, Final Report* (retrieved April 12, 2007, from <http://www.activelivingresearch.org/node/10636>). In the introduction to the *Final Report* the authors state:

Physical features of the built environment influence the quality of the walking environment both directly and indirectly through the perceptions and sensitivities of individuals. Our study focuses on urban design qualities, qualities of the environment that depend on physical features....All of these factors--physical features, perceptual qualities, and individual reactions--influence the way an individual feels about the environment as a place to walk. (p. 1)

The results of the Ewing et al. (2006) study were also used to develop a field manual titled *Measuring Urban Design Qualities: An Illustrated Field Manual* (Clemente, Ewing, Handy, Brownson, & Winston (n.d.), and an audit instrument (score sheet) that is accessible to other researchers for continued studies on the urban design qualities of a walkable urban street (retrieved April 12, 2007 from <http://www.activelivingresearch.org/node/10635>).

The Field Manual and Final Report from the study provided a precondition and foundation for my study. Based on Ewing et al.'s (2006) literature review, the study focused on eight urban design qualities (UDQs) that appeared to be valued by users of urban spaces: imageability, legibility, visual enclosure, human scale, transparency, linkage, complexity, and coherence. Using expert opinion, statistical analysis, and field testing, the research team ultimately developed definitions and protocols for five of the design qualities: enclosure, transparency, human scale, complexity, and imageability. They subsequently developed the Field Manual and audit instrument that include instructions for rating an urban street for walkability by quantitatively measuring certain features related to the five urban design qualities. The manual and score sheet provided a framework within which to study design codes and the streets that are built from these codes.

My study assumes that the audit instrument is a legitimate tool for assessing the walkable qualities of a street, based on the scientific rigor of the study from which it was developed. My study also used historic streets as the “gold standard” to compare audit scores for walkable qualities. Using historic streets was assumed to be a legitimate standard based on the reputation and qualifications of the organization (Walkable Communities, Inc.) that judged the historic streets to be highly walkable.

## **Rationale and Objectives**

One reason for studying the walkability of community streets is the public health goal to increase utilitarian physical activity, which is based on the theory that people might walk more if the built environment encouraged physical activity. Another reason is to study the visual quality of streets, which is important to designers for development of standards and codes, and also to policymakers for the establishment of design policy (Ataov, 1998).

Policymakers in many communities are moving beyond the concept of design guidelines to aesthetic codes, such as FBCs, to preserve the character of their towns and to make them more livable and walkable. Planners and designers are advocating the codes as an effective tool for achieving their goals for walkability. Community officials see FBCs as a viable legal method to control the aesthetic appearance of their community. Although planners know how to develop, write, implement, and enforce the codes, the question remains about the codes' potential to achieve the community's goals for walkability (Watson, 2001). The three objectives of my study are to analyze (a) streets that have been created by the application of FBCs, (b) the Form-Based codes that were used to create the streets, and (c) the users' observations of the FBC streets to establish the relationship between the streets and the codes.

## **Hypothesis**

The core concept of my study is that well-crafted design codes can create an urban street that will encourage a high level of pedestrian activity. This concept is based on the fundamental aspect of code and policy development for aesthetic control, which is the notion that physical design and aesthetic qualities can be measured, described, and quantified.

It is also based on a primary goal of the codes, which is to shape a high-quality, walkable public realm (Katz, 2004; Lewis, 2004; Nasar, 1994; Ulrich, 1983). The core concept for this

study is further refined to specify that Form-Based codes can create an urban street that will encourage a high level of pedestrian activity.

### **Scope of Work**

Data collection for my study occurred in three phases using three methodologies. Phase I included a visual survey (audit) of historic and FBC streets in different communities. Phase II was an interview with users (business owners) from an historic street and a FBC street that were surveyed in the Phase I audit. Phase III consisted of a review and summary of data from the written Form-Based codes.

#### **Phase I: Street Survey**

The intent of the Phase I audit of the historic walkable streets was to provide the initial framework, a stratified set of UDQs, on which to organize and investigate the research question. The Phase I audit of the FBC streets compared the urban design qualities of FBC streets to the UDQs of the historic streets. This comparison was used to find out if the streets shared similar urban design qualities, and also to determine if the UDQs used in the audit provided a reasonable framework for predicting the potential of FBCs to create walkable streets. My study's premise was if the audit scores showed that the same UDQ features appear on both the FBC streets and the historic walkable streets, then the codes are regulating the same features found on historic walkable streets. The implication would follow that FBCs have the potential to create walkable urban streets that are comparable to known walkable streets.

#### **Phase II: User Interviews**

The Phase II interviews were conducted to investigate which features and UDQs the users perceive to be meaningful for a walkable street compared to the features regulated by code. My study's premise was that if the features of value to the users are present in the codes, then the

codes have the potential to create a walkable street both from the everyday users' perspective and the design professional (code writers') perspective.

### **Phase III: Form-Based Code Review**

To find out if the codes were in fact regulating the features found on the FBC streets and to determine the UDQ most influenced by the FBCs, a review of 30 codes (including those of the audited streets) was completed in Phase III. The review was used to investigate the assumption that the codes are regulating the same features that create the UDQs found on the historic walkable streets. If the codes do regulate the same features found on historic walkable streets this would explain how the FBCs can create streets that are walkable.

## CHAPTER 2 LITERATURE REVIEW

### **Introduction**

The study of the relationship of the built environment to physical health is complex and requires consideration of a wide range of issues. The first section of the literature review, “Health and the Built Environment,” examines studies concerned with the link between physical activity behaviors, the built environment, and health. The discussion includes the distinction between walking for transportation and recreation and also community design as it relates to walking.

The second is a brief history of the relationship between public health and urban form. This section includes the early theories and studies that linked health to urban form, the contributions of planners and landscape architects, the first use of codes and zoning ordinances to improve health, and the impact of the Garden City Movement on present-day suburban form.

The third section, “Design of Walkable Streets,” describes the aesthetic design qualities of streets, such as enclosure, human scale, transparency, complexity, and imageability, as they relate to the street form and the preferences and walking behaviors of the pedestrian. The fourth, “Study of Environmental Aesthetics,” focuses on the aesthetic response: the study of emotional appraisals and preferences for the environment and how people respond behaviorally to visual quality. This section describes the models used to study the relationship between measurable physical qualities and experience of the users.

The fifth section, “Urban Design Standards and Codes”, discusses the use of codes to control aesthetics and the issues with writing codes that describe and quantify aesthetics based on subjective design qualities. The last section, “Aesthetic Codes and Walkable Streets” considers the use of Form-Based codes, which are new types of codes that regulate form rather than use, to

develop streets that are pedestrian-oriented. The codes include standards for the appearance of buildings, sidewalks, and streets with the primary purpose of creating a walkable public realm.

### **Health and the Built Environment**

Interest has grown in how the relationship between inactivity, health, and obesity might be affected by the design and form of the built environment. One area of concern is the effect of urban sprawl (distance to destinations) and automobile dependency on walking. Another is the effect of urban design characteristics, both aesthetic and functional, on walking behavior.

### **Link Between Physical Activity and Health**

Although research has shown an established and solid relationship between physical activity and chronic disease, no study has shown a direct relationship between obesity, walking, and characteristics of the built environment (Ewing et al., 2003; Frank et al., 2003; McCann et al., 2003). The 1996 U.S. Surgeon General's report, *Physical Activity and Health* (USDHHS, 1996), showed that moderate physical activity reduced the risks of developing or dying from some of the leading causes of illness. The report found that regular physical activity can improve health by reducing the risk of coronary heart disease, stroke, colon and breast cancer, premature death, osteoporosis, non-insulin-dependent diabetes, and high blood pressure. Physical activity can also help reduce feelings of depression and promote psychological well-being (USDHHS, 1996).

The health-related components of physical fitness include cardiovascular endurance, flexibility, muscular strength, muscular endurance, and body composition. The mechanisms by which physical activity can reduce various risks is by improving cardiovascular health, including blood lipid and cholesterol profiles, lowering blood sugar, and blood pressure, controlling weight, and helping to maintain and increase bone density and strong muscles and joints (Evans, 1987; McArdel, Katch, & Katch, 1981; Stokes, Moore, & Moore, 1988).

Obesity has been a major focus of health and physical activity studies because it has been associated with many of the chronic health problems previously mentioned and it is directly affected by physical activity. A recent study by the Rand Institute reported that obesity is more strongly linked to chronic diseases than drinking, smoking, or living in poverty (Hill, Wyatt, Reed, & Peters, 2003). Obesity in the United States has reached epidemic proportions both in adults and children. The 1999-2000 National Health and Nutrition Examination Survey (NHANES) showed that approximately 31% of the adult population was obese, with a body mass index (BMI) greater than 30 kg/m<sup>2</sup>, and 65% were overweight with a BMI greater than 25 kg/m<sup>2</sup>. Body mass index is a measure of weight in relation to height to give an index of healthy weights for a given height (divide body weight in kilograms by square of height in meters). Measures above 25 kg/m<sup>2</sup> are considered overweight, above 30 kg/m<sup>2</sup> are considered obese (Hill et al., 2003). Studying children aged 6 to 19 years, 15% are overweight, and 60% of 5 to 10 year-old-children manifest at least one cardiovascular disease risk factor. It is also estimated that one-third of all U.S. children will develop type II diabetes (Frumkin et al., 2004; McCann & Ewing, 2003; Ewing et al., 2006; Perdue et al., 2003). Prevention of weight gain or minor weight loss in high risk groups has been shown to be very effective in preventing the development of hypertension, type II diabetes, and cardiovascular disease (Gill, 2002). Physical inactivity and excess weight now account for more than 300,000 premature deaths each year. Among preventable causes of death, complications due to obesity are second only to tobacco-related deaths (Ewing et al., 2003).

Obesity has many causes, including an environment that promotes excessive food consumption and a sedentary lifestyle. While we can identify the characteristics of our environment that promote eating, it is not as easy to define the characteristics that discourage

physical activity (Peters, 2004). We have engineered physical activity out of our lives with sedentary work, leisure time, and environmental features that discourage physical activity. The median weight gain in the adult population is two pounds per year. A positive energy balance of 100 calories a day can explain the weight gain of 90% of the population. Walking an additional mile each day would burn the approximately 100 calories (kcal) that cause weight gain (Peters, 2004). Research shows that activity does not have to be strenuous to achieve health benefits. People who are inactive can improve their health through moderate activity on a regular basis (USDHHS, 1996). Choosing an active lifestyle or utilitarian physical activity, as opposed to leisure time or recreational physical activity seems the most promising approach. The public health goal is to increase moderate-intensity physical activity and for most people walking in local neighborhoods is the most realistic activity (Reed et al., 2004).

The guidelines of the U.S. Department of Health and Human Services (USDHHS) recommend that adults get a minimum of 30 minutes of moderate-intensity physical activity (PA), five times a week or more and that children get 60 minutes of age-appropriate physical activity. However the guidelines for weight loss are higher, with a recommended 60 to 90 minutes of PA, five to seven times a week. A moderate amount of physical activity uses approximately 150 calories of energy per day, or 1,000 calories per week. Activities that fall into the moderate-intensity category include walking (1.75 miles in 35 minutes to 2 miles in 30 minutes) and bicycling (5 miles in 30 minutes or 4 miles in 15 minutes). The calories expended depend on the intensity and fitness level of the person. Currently more than 60% of adults do not achieve the recommended amount of activity and 25% are not active at all (USDHHS, 1996).

## **Link Between Community Design and Health**

Two main branches of research link physical activity and the built environment. One branch focuses on physical activity from the public health perspective, which is generally recreational physical activity. The other branch looks at physical activity (walking and bicycling) from the urban planning and transportation perspective, which is utilitarian physical activity (secondary to other goals). Considering physical activity from the two perspectives is important because characteristics of the built environment that facilitate or constrain physical activity may depend on the purpose of the activity (Ewing et al., 2006).

The built environment influences both perspectives, particularly utilitarian physical activity, which is the ability to commute by foot, bicycle, and transit (transit users walk more). Characteristics that impact utilitarian trips include the proximity of destinations, linkage of path network, design of the streetscape, and availability of motorized transport. Characteristics that influence leisure and recreation trips include the presence, design, and aesthetics of recreation facilities and streetscape, perceptions of safety, and other people being active (Ewing et al., 2006; Hoehner et al., 2005; McCann & Ewing, 2003; Northridge & Sclar, 2003; Owen et al., 2004; Pikora, Giles-Corti, Bull, Jamrozik, & Donovan, 2002).

Most of the recent studies that link community design to health have focused on urban sprawl because the characteristics of sprawl appear to impact physical activity (McCann & Ewing, 2003). Ewing et al. (2003) defined sprawl as an environment characterized by (a) a widely dispersed population in low density developments; (b) a strict separation of uses such as commercial, home, and work; (c) lack of a distinct activity center such as a downtown; and (d) lack of connectivity through a network of roads.

An association exists between urban sprawl and driving that suggests a potential pathway of causality between urban sprawl and poor health: Urban sprawl leads to increased automobile use, which leads to decreased physical activity, which leads to obesity, which leads to increased cardiovascular disease, diabetes and other chronic health problems (Lopez, 2004).

One study looked at physical activity as reported by the *Behavior Risk Factor Surveillance System* (BRFSS) for three years in 448 counties and 83 metropolitan areas; each county and city was scored on the sprawl index. The study found that more sprawl was clearly associated with less walking. Also, as the level of sprawl increased, so did hypertension, body weight, and probability of being obese (McCann & Ewing, 2003).

In a study by Frank et al. (2005) to link objectively measured physical activity with objectively measured urban form, using the *Strategies for Metropolitan Atlanta's Regional Transportation and Air Quality* (SMARTRAQ) questionnaire, measures of land use mix, residential density, and intersection density were positively related with the number of minutes of moderate physical activity per day. Data from the Atlanta region showed significantly lower obesity rates for those who reside in more compact, denser, pedestrian friendly, transit-oriented communities. Studies have found similar results when looking at the association between the urban form (land use and distance walked) and the probability of being overweight.

While these studies do not affirm causality, the results lend support to the limited evidence linking urban form with activity levels and obesity (Ewing et al., 2003; Frank et al., 2004). Other constraints to physical activity in the environment include safety (both from crime and traffic), weather, and lack of facilities and opportunities (Frumkin et al., 2004).

## **Components of Walkable Communities**

For physical activity, the most important issues related to sprawl are two core land use concepts-- density and land use mix and two core transportation concepts-- automobile dependency and connectivity (Frumkin et al., 2004). The density and land use mix concept measures the degree of proximity-- or the functional distance between where we live, work, and play-- that has implications for travel behavior. High density is usually associated with shorter trips, increased transportation options, and reduced vehicle ownership. Although higher densities are often correlated with a high number of destinations, a highly dense area could have few trip destinations. However, a high level of both land use mix and density typically produces a high number of destinations (Frank et al., 2003; Frumkin et al., 2004).

Studies show that the distance to destinations is an important factor that affects whether or not people decide to walk. Distance is more of a determinant than weather, physical difficulty, safety, or fear of crime. Having close destinations proved to be the strongest correlate of transportation walking (Hoehner et al., 2005; Southworth, 2005). Pedestrians will choose the shortest path and, for that reason, reducing trip distances is a critical reason for links (connectivity) within a larger network (Echeverria, Diez-Roux, & Link, 2004; Reed & Ainsworth, 2002; Zacharias, 2001).

Physical proximity is also a major factor in trail use. Recreation trails have been found to be a useful environmental and policy intervention to promote regular activity (Reed & Ainsworth, 2004). Neighborhood variables are stronger predictors of physical activity and walking than community variables, suggesting that interventions should target neighborhood or proximal locations (Addy, et al., 2004).

Although a compact community is desirable, no known level or critical threshold of “compactness” of community design exists where there is a measurable influence on physical activity (Ewing, Frank, & Kreutzer, 2006).

The automobile dependency and connectivity concepts are concerned with highly connected travel routes and shorter distances. Connectivity affects how destinations are linked. Well-connected systems, such as the grid pattern, shorten the ground distances with more intersections (Frumkin et al., 2004). Alexander et al. (1977) and Jacobs (1993) recommended street connections and pedestrian crossings every 200 to 300 feet, although others (Appleyard, 1981) argued that too much connectivity can increase traffic and decrease walkability.

A healthy community has a combination of components that promote physical activity. Neighborhoods are more pedestrian-oriented and people tend to walk and bike more if they have high densities of development, mixed land use (retail, commercial, and residential), a high connectivity street network with many intersections and shorter blocks, human-scale streets in spatial and built form, and desirable aesthetic qualities (Boslaugh et al., 2004; Handy et al., 2002).

The Centers for Disease Control (CDC) define Active Community Environments (ACES) as places where people of all ages can easily participate in physical activity. The hypothesized ACES model is as follows: Active Community Environments (walkable and safe) leads to greater physical activity which leads to lower obesity which leads to fewer weight-related chronic conditions which leads to better overall health. Studies by Doyle, Kelly-Schwartz, Schlossberg, and Stockard (2006) and Frank et al. (2003) provided some support for this model. They found that individuals who live in counties that have better walking conditions and lower rates of crime tend to walk and exercise more, averaging 195 minutes/week of physical activity.

These individuals have lower body mass indices (35% overweight) than people in counties with poor walking conditions and more crime-prone areas. This latter group of people averaged 130 minutes/week of activity and was 60% overweight.

### **Walking Behavior**

Other factors that influence walking behaviors include demographics (socioeconomics, age, race, and gender) and individual lifestyles (attitudes and beliefs, behavior and skills, and social and cultural issues) (Frumkin et al., 2004). The most common personal barriers to exercise are lack of time (real and perceived), physical inability, lack of motivation, lack of social support, fatigue, childcare responsibilities, and lack of knowledge (Frank et al., 2003).

Attitudes and preferences are also important in the travel choices made by individuals. Many choose to drive short distances rather than walk. The national Personal Transportation Survey (1984) found that 70% of people will walk no more than 500 feet for daily errands, 40% will walk one-fifth of a mile, and only 10% are willing to walk a half mile. A study by Southworth (2005) showed similar results: 10% will walk up to a half mile (approximately 8-10 minutes), but most will only walk a distance ranging from 400 feet to a quarter mile. Studies revealed that in sprawling metropolitan areas, 41% of all trips were shorter than two miles and 28% shorter than one mile, yet Americans use their cars for 66% of trips up to a mile and for 89% of trips between one to two miles. In the United States only 9% of total trips were by foot and 84% were by car in 1990 (Pucher & Dijkstra, 2003; Southworth, 2005). Even when walking is feasible, many prefer to drive. More research is needed on how the distance people are willing to walk is impacted by design features (Frumkin et al., 2004).

## **Determinants of Walkability**

Walking can be for exercise, pleasure, or transport, and the environment in which walking typically takes place can be designed with pedestrians in mind (Leslie et al., 2005). Strategies to modify the environment are particularly important because they can benefit all people exposed to the environment, which may be more effective and cost-efficient than individual behavior modification (Boslaugh et al., 2004; Reed et al., 2004; Sallis et al., 1998). Studies have shown that individually focused interventions have not created long-term change or population-wide change, and they are not cost-effective (Saelens, Sallis, Black, & Chen, 2003; Sallis et al., 1998).

A proposed framework for classifying determinants of walkability includes four categories: functional, safety, destinations, and aesthetics. Functional includes the physical attributes of the street or path, such as width and continuity. Safety includes street crossings, lighting, and passive surveillance (eyes on the street). Destinations include parks, transit nodes, stores, and restaurants. Aesthetics refers to the attractiveness or appeal of the place (Frank et al., 2003).

Of the four categories, the aesthetic qualities are the most intangible and are typically described rather than quantitatively measured. Some of the factors that contribute to aesthetic qualities include building design (windows and doors), landscaping, paving materials, street trees, benches, signage, and lighting, which are all qualities that contribute to a strong “sense of place” (Brownson et al., 2004; Handy et al., 2002; Hoehner et al., 2005; Leslie et al., 2005). Few studies have evaluated the effects of these street level characteristics or looked at issues such as the quality of the elements. Little consensus exists on the relative importance of the visual details and landscape features, or the spatial relationships on the desirability of places for walking (Hoehner et al., 2005; Zacharias 2001).

Only a small body of evidence exists on how best to measure the user's perceptions of the environmental factors for walkability (particularly neighborhood) and how these perceptions may be related to objectively evaluated elements (Leslie et al., 2005; Saelens et al., 2003). Of particular interest from a designer's perspective are questions about how perception of the environment influences walking behavior, especially on issues such as the sensory experience, physical comfort, and the visual and auditory experience (Zacharias, 2001).

In studies that compared resident's perception of walkability, a significant difference can be seen between ratings of those who live in "high" and "low" walkable areas for density, land-use mix, street connectivity, and infrastructure for walking. Residents in high walkability neighborhoods spend about 70 more minutes in moderate-intensity physical activity during the week than residents in low walkability neighborhoods. The residents in the high walkability neighborhoods reported spending more time walking for errands and during breaks at work or school (Leslie et al., 2005; Echeverria et al., 2004; Saelens et al., 2003).

### **Short History of Public Health and Urban Form**

Public health and the built environment have been linked for centuries in one form or another, but a once strong relationship has diminished in recent years. Contemporary health problems are bringing renewed interest in the form of the built environment as it relates to health.

#### **Traditional Link**

The traditional link with the built environment addressed health issues, such as sanitation, infectious diseases, toxic wastes, fire codes, workplace safety, lead paint, and accessible design (Jackson, 2003). Early cities posed many threats from sanitary problems such as garbage, noxious trades (tanning, slaughtering, etc.), sewage, crowded housing, and contaminated water and air. These conditions led to high rates of infectious diseases (Frumkin et al., 2004). Health-

based zoning laws were enacted as the primary intervention to alleviate most of the place-oriented health problems. For example, zoning laws, which blocked high density work-live developments, helped prevent the spread, but not the cure, of infectious diseases by proximity (Jackson, 2003).

From 1793 to 1806, yellow fever was the scourge of cities. It was during this time that quarantine stations, local health officers, and local health agencies (referred to as “committees on health” or “boards of health”) were established. They became the forerunners of today’s U.S. Public Health Service (Frumkin et al., 2004).

In 1798, Valentine Seaman, a surgeon at New York Hospital, began to investigate the yellow fever outbreak in his city. He argued that the origin of the outbreak was the smell (putrid miasmata) from the city’s garbage and sewer in the harbor area. Although this was a commonly held belief at the time, he was the first to use maps to show the yellow fever cases in relation to the location of the waste and spatial configuration of the built environment. By pinpointing the outbreak of cases in certain low lying areas where water and sewage collected, he was able to connect disease to the built form, and he argued that the environment itself was in need of repair. In 1819, Felix Pascalis mapped yellow fever outbreaks in New York by order of occurrence. By mapping the range of urban cases he made an argument that the foul air caused the disease rather than simply conveyed it. He used his maps to make a case for an urban sanitation infrastructure. Although it would be another century and the invention of the microscope to disprove the miasmatic theory of disease, Seaman, Pascalis and other New York Board of Health researchers were the first to connect the urban form to health (Koch, 2005).

In the 1840s, Edmund Chadwick, the head of the London Board of Health, mapped the incidence of cholera, poverty, and population density per acre, thus showing the relationship of

class and place to the incidence of health and disease (Koch, 2005). At the same time, John Snow, a London physician, was working in the hardest hit areas of London when he began mapping cholera locations. Snow put forth the theory that cholera was introduced into the area through the water, not air, and passed through person-to-person contact. This was a radical and controversial argument that implicated the private and city waterworks that drew their water from the Thames River. His South London study in 1855 of the Broad Street water pump area showed the relationship of deaths to real travel time from the well. The map, presenting the twisted and often truncated streets of London, demonstrated that those with the shortest walking distance to the well (most frequent users) had the higher incidence of death, thus connecting behavior influenced by the built environment to health (Koch, 2005). Snow's study again highlighted the connection between the built environment and health. Although he failed to convince his contemporaries of his argument, this now famous study made John Snow the "patron saint" of the disciplines of public health and epidemiology (Koch, 2005).

In 1864 the Council of Hygiene and Public Health in New York issued a report on the rate of illness and sanitary infrastructure that led to the passage of the landmark New York Metropolitan Health Bill of 1866, which created a board of health to oversee sanitation in the city (Frank et al., 2003). In 1874, the American Public Health Association began a campaign to clean the air in Charleston, South Carolina, and other cities followed, beginning the sanitation reform movement (Frumkin et al., 2004).

### **Sanitation Reform**

The time between the mid-1800s and the mid-1900s was a period when a wide range of architects, planners, activists, politicians, and other professionals sought to improve the chaotic, unhealthy city of the industrial era. Public health concerns led to the idea of the horizontal city

with decentralized settlement patterns. Four different periods underscore the importance of health in the shaping of urban form: sanitation reform, tenement housing reform, establishment of zoning as a standard planning tool, and evolution of the garden city in city planning (Frank et al., 2003).

In addition to the medical community, the sanitation reform movement involved architects, planners, and landscape architects. The most significant contributions were made by Fredrick Law Olmsted, a landscape architect who planned and designed several suburbs, led the urban parks movement, and published widely on the health of urban dwellers and urban form. As Secretary of the U.S. Sanitary Commission, he wrote that the health of urban dwellers could be improved by abandoning the compact building of towns and adopting a custom of laying them out in a larger space for air and sunlight. He advocated wide boulevards, street trees, urban parks, lot and building redesign and satellite suburbs as the ideal urban form-- a solution that presaged the 20<sup>th</sup> century American city (Frank et al., 2003).

### **Tenement Housing Reform**

Although the bacteriological revolution downplayed the contribution of local conditions to disease, housing reformers in the Progressive Era (1900-1914) continued to attach great importance to health of urban dwellers, focusing on the triple threat of poverty, unsanitary housing and overcrowding. Frank Veiller, chair of the New York Tenement House Commission, fought for limitations on building heights, lot depth, block sizes, street layout, and zoning for the entire city. His codes set the stage for New York's first zoning ordinance and became the basis for housing codes across the United States. The idea that high density of structures contributed to unhealthy living became institutionalized during World War II when the Federal Housing Administration developed model subdivision and health codes (Frank et al., 2003).

## **Land Use Zoning**

Proponents of zoning believed it was a way to improve the health of urban residents. But unlike housing reformers, they saw zoning as a way to protect the health and well-being of the upper and middle class by creating--through zoning--a decentralized, healthy, suburban environment. Health, safety, and welfare continue to be the legal basis for zoning today, which is the primary determinant of land use patterns in American cities.

Modern zoning began in Germany as a way to control development and public health problems, but the German system never completely separated zoning into uses. When American planners adapted the system, they believed that not only should housing be separated from non-residential development, but that residential districts should also be separated by housing type, such as single-family and multi-family units. In 1926, the Supreme Court in the *Euclid v. Ambler Realty* case decided in support of the city ordinance that mandated districts that separated residential and industrial uses, stating that the city had the power to legislate for the health, safety, and welfare of its citizens. The Supreme Court's decision served to institutionalize zoning in the 1920s, and lay the foundation for low development densities in the suburbs of American cities today (Frank et al., 2003; Schilling & Linton, 2005).

## **Garden City Movement**

The appearance of the automobile, decline of the trolley lines, escalation of highway infrastructure, and government subsidized mortgages pushed growth to the suburbs and vastly expanded metropolitan areas (Jackson, 2003). The Garden City model, as an alternative to the suburban model, envisioned a number of small cities separated by greenbelts and linked by inter-city rail to carry goods and people. In 1902, Ebenezer Howard planned the physical layout of his garden city with institutional buildings in the center, housing in the middle, and industry on the

outskirts. In 1923, the Regional Planning Association of America, which included some of the most influential people in American planning history, endorsed development based on the Garden City model. Although the members never built a true garden city, they applied the concept to several developments, including Sunnyside Gardens in Queens and Radburn in New Jersey. In both developments, they substituted the grid street pattern for a dendritic street pattern, placing great emphasis on the car, one of many ways that planners were helping facilitate the explosive growth of automobile use. The grid was seen as dangerous for pedestrians with so many crossings where every street was a through street. The Garden City Movement was an attempt to create an alternative to the standard suburb and create a healthy environment, but the solution helped to institutionalize the concept of the detached subdivision in American cities (Frank et al., 2003).

In the 1960s, federal efforts to resolve the “urban crises” of the 20<sup>th</sup> century included the National Commission on Urban Problems, the President’s Commission on Urban Housing, Housing and Urban Development Act, Model Cities Program, and the Fair Housing Act (Frumkin et al., 2004). A century ago the leading cause of death was infectious and communicable diseases. Today, the urban design solutions to those problems are now contributing to the leading cause of death today--lifestyle habits that lead to chronic diseases (Frank et al., 2003). The long history of public health shows that the form of the built environment has clearly been a factor in health and disease in cities. Lifestyle risks today, including physical inactivity, may be linked to the design characteristics of streets that affect the perception of walkability.

### **Design of Walkable Streets**

The urban space--the street-- is typically defined as the volumetric, three-dimensional void that is visually and or physically contained by buildings or the open area identifiable between

and around buildings (Orr, 1983). Many streets are known by a singular quality that distinguishes them. A singular quality can be a special use or activity, or a characteristic spatial form and details, such as street furniture, lighting or planting patterns that create a visual and functional hierarchy (Lynch, 1960). These design features, which make up the visual character of the street and can be expressed as urban design qualities, are based on theories and principles of design for public social spaces. But these design features have not been studied in detail or rated for significance for walkability (Southworth 2005). Studies do show, however, that people are more likely to meet recommended levels of activity if they live on high quality and aesthetically pleasing streets with features such as a nice tree canopy, sidewalks, shops, windows on the ground floor, open green space, and varied architecture with small-scale detail (Giles-Corti et al., 2003; Southworth, 2005; Zacharias, 2001).

### **Urban Design Qualities for Public Spaces**

The literature on urban design supports the concept that urban design qualities are linked to the use of space and to physical features which create visual character or urban quality. The literature also describes how the features can be objectively measured and quantified. Important criteria used to measure visual character include: a defined area (the block face or facades of buildings in one block); an established set of design features, such as windows, number of stories, roof shape, and materials; and a critical frequency in which those design features are found on the building facades (Smith, 2003; Stamps, 2000). The same criteria can be used to measure the character of an urban street as that street relates to walkability. However, the defined area includes the building facade on both sides of the street, the sidewalks or pedestrian path, and the street or carpath.

An essential notion of visual character is the pattern that is created by the abstract features of buildings, such as the lines and edges of windows, walls, and roofs. People recognize and respond to the aesthetic message that is conveyed by the pattern. Studies show common preferences for buildings based on small-scale ornamentation, material, color, and patterning (Smith, 2003). Another important concept for the design of walkable streets is that expert judgments and public preferences for the amount of detail are strongly correlated. In studies that compared experts' judgments with public impressions of how well buildings fit their context, the highest correlation was between the facade detailing followed by the height, shape, and complexity of the building (Stamps, 2000). The high correlation of preferences has implications for the development of codes and the design of streets by professionals--if there is agreement on building detail, professionally designed streets should appeal to the everyday user.

Several urban design qualities are valued by users of urban spaces and presumed to be related to walkability: enclosure, transparency, human scale, complexity, and imageability (Ewing et al., 2005). Each of these distinct design qualities are defined or described by certain quantitative (measureable) design features that create the quality. Literature from many fields, including architecture, landscape architecture, and environmental psychology, support the concept of urban design qualities as a method to define and describe walkable urban streets. The merits of each urban design quality are discussed in terms of the features associated with that quality and the relationship to walkability.

### **Enclosure**

Enclosure refers to the degree to which the building walls, trees, and other vertical elements visually define the streets (Ewing et al., 2005). Spaces between buildings that also affect enclosure include the courtyards, plazas, and green spaces along the street. Enclosure is

often described as having the sense of an outdoor room or a space where the shape of the space is as strong as the shape of the buildings around it (Alexander et al., 1977; Cullen, 1961). Unwin (2003) described a space as the relationship between an object (in the urban context, usually a building) and the person who perceives it. It is primarily determined by sight, but it can also be affected by smell, noise, and touch (tactile). Human orientation is strongly related to four horizontal directions: front, back, and sides. The enclosure of the two parallel walls and the long linear shape of the street control those four horizontal directions with fixed boundaries that create a room-like sense of security, focus, and direction (Jacobs, 1993; Unwin, 2003). In the space between two pieces of architecture an enclosing force works between the buildings that create the space. With increasing complexity of the building form (concave and convex forms), the exterior space becomes a stronger positive space (Ashihara, 1970).

The height of the walls is crucial to the sense of enclosure and orientation. If walls are too low in relation to the width of the street, outward views are not contained enough to provide a sense of unifying space. Obtaining the right street wall height to width ratio is essential to defining the street (Hedman, 1984). Alexander et al. (1977) stated that the total width of the street, building to building, should not exceed the building heights. Hedman (1984) and Ashihara (1970) agreed that a 1:1 height-to-width ratio gives a strong spatial definition because the street wall height limits the sky view, almost completely containing the view. Jacobs (1993) suggested a 1:2 building height-to-street width ratio.

Streets have two problems with containing space. Because they do not have a roof or ends, the building walls must contain the space. To overcome this design problem, two conditions must be met: (a) A relatively uniform height of street space must exist to give the street cross-section strong unifying proportions and prevent what Hedman (1984) described as “leakage” of

space; and (b) the facades framing the street should provide “grips” or “snags” in the form of facade details, texture, and materials to secure and hold the space in place. Architectural details, such as deep, large indentations, bold projections, and a rich texture, help to hold and define the space. Orr (1985) also described texture on surfaces as giving the impression of gripping the space. He explained that qualities of the texture communicate the scale because of our past association with that texture. Complexity and rich detail, repeated from building to building (colors included), also influence shadow patterns which provide additional texture to hold the space (Hedman, 1984).

Using a hierarchy of scaled features both vertically and horizontally provides a means for reading the building height if the features are a size with which most people are familiar (Hedman, 1984). Details such as belt courses and cornices interrupt the vertical flow and terminate facades to help define the space. The cornice suggests the presence of a horizontal plane--inferring a roof over the street. The silhouettes of roof lines also contain the space if they have a similar pitch and height (Hedman, 1984; Unwin, 2003). Parts of a building, such as major masses, percent of windows, bases or caps, and areas of different color, texture, or material, can also influence the scale of buildings and the sense of space (Orr, 1985; Smith, 2003).

Many new urbanists advocate closing vistas at street ends with prominent buildings, monuments, or fountains to achieve enclosure on all sides (Ewing et al., 2005). Jacobs (1993) stated that streets should have clearly marked end points to define that area and serve as a reference point, and Curran (1983) noted that another dimension of streets, the length, can be manipulated with the use of curvilinear patterns, bends and building projections to produce closure.

Street trees can also visually define a space with a ceiling of branches and leaves that horizontally implies a ceiling, and they can suggest the vertical enclosure of an area with their trunks. The key to influencing enclosure with trees is the close spacing of the trees along the street (Arnold, 1993).

## **Transparency**

Transparency is described as the degree to which people can see or perceive elements beyond the edge of a street, including the interior of buildings. Features that influence transparency include trees, walls, windows, doors, fences, and midblock openings (Ewing et al., 2005). Transparency is most critical at the street level. The classic example is the display window in street level retail establishments where pedestrians can see into the building, as opposed to solid walls or reflective glass buildings (Ewing et al., 2005). Windows visually extend the interior out and allow the public to see the interior uses that make the street level more visually complex (Curran, 1983).

Openings (doors) also extend and expand interior spaces so that the interior and exterior have visual and functional overlap. Openings also provide information that makes the experience on the street more meaningful by sending visual clues regarding uses, access, and linkage, whereas blank walls have the opposite effect (Curran, 1983; Jacobs, 1993). The proportions of windows, bays, and doorways to other features (the proportion of void to solid), and variations in size and character of openings provide the contrast between transparency and enclosure.

Small trees can obstruct transparency by blocking views. However, large trees with high canopies create a partially transparent ceiling that gives an awareness of space beyond, creating both transparency and enclosure (Arnold, 1993).

## **Human Scale**

Ewing et al. (2005) described human scale as referring to a size or texture of physical elements that match the proportions and size of humans and relate to the slow speed at which humans walk. Human scale is important when walking close to buildings on a street because the person has a direct sense of the size of the building as it relates to human anthropometric measures (Orr, 1985). Visual elements such as street trees, pavement, architectural details, and street furniture contribute to human scale because they are typically features that people are familiar with in terms of size, for example, tables and chairs relate to the size of the human body.

The range of human vision is a factor in the perception of street space and scale. Our basic viewing orientation is aligned on the horizon in a close parallel to the ground. In this way, scale relates directly to our field of vision. When looking straight ahead, a person has approximately two-thirds of his view above the eye level plane which can affect the sense of scale in buildings (Orr, 1985). Urban designers differ on their definition of human scale with regard to the height and massing of buildings, finding anything from three stories to six stories to be acceptable. Alexander et al. (1977) limited buildings to four stories; while Lennard and Lennard (1995) found six stories to be acceptable.

The width of the building also affects scale, particularly in proportion to the height. Building mass is primarily determined by the cross-sectional area of the building, followed by the amount of windows, and finally the amount of facade articulation or details (Ewing et al., 2005; Stamps, 1998). The presence of windows, the use of horizontal or vertical partitions, the thickness of the vertical elements, and the overall proportion are all associated with less apparent mass (Stamps, 2000).

Perspective can also create the perception of human scale particularly with regard to perceived distance and effort to cover a distance. Perspective also has an effect on the spatial experience in street corridors. The visual distortion on the linear edges of buildings links the buildings and produces a directional quality that directs people along the pathway (Curran, 1983; Orr 1985).

Building features, such as arcades and awnings, give streets enclosure and human scale that support the commercial roles of the street. Seating adjacent to buildings and extended into spaces also gives a supportive transition zone for the main function of walking and provides human scale with furniture (Curran, 1983). Street trees can also affect human scale by creating a smaller space within the large space of the street, particularly if the buildings are tall and the street wide. Arnold (1993) stated that trees are needed on streets which are more than 40 feet wide, to achieve human scale.

### **Complexity**

Complexity refers to visual variety in the physical environment. On the street complexity includes: architectural materials; color; ornamentation; diverse building shapes and sizes; various elements such as landscape plants, street furniture, and signage; and the movement and color from human activity (Ewing et al., 2005). Rapoport (1990) described complexity as the number of noticeable differences that a viewer observes in a defined time period, which relates complexity to speed of movement. Pedestrians require a high level of complexity to hold their interest. An environment has low levels of usable information if elements are too few or too similar, if they are too predictable, or if they are too unordered (Ewing et al., 2005). People enjoy areas with multiple levels of visual stimuli and scenes that can be re-examined (especially in a familiar area that they visit often). On a day-to-day basis, a degree of complexity will renew the

interest of the regular viewer, but simplicity and order are also needed to facilitate comprehension of the larger composition by the infrequent viewer (Hedman, 1984). Jacobs (1993) described the most popular streets as those cluttered with humans and life. Ewing et al. (2005) said that pedestrian activity adds to complexity. People are attracted to and feel safer around other people.

Coherence (sometimes referred to as unity) can control complexity through the orderly arrangement of elements in the environment, giving a sense of visual order, for example, buildings that are similar, but not the same, in height and character (Jacobs, 1993). Coherence is achieved through consistent and complementary scale, character, and arrangement of buildings, paving material, plant material, and street furniture (Ewing et al., 2005). Features of buildings that create visual coherence, particularly when repeated, include: the silhouette, material, color, surface detail, building scale, location of entryways, proportion and placement of windows and doorways, and style of architecture. The spacing between buildings and setbacks from the street also contribute to coherence (Groat, 1989; Hedman, 1984).

Empirical studies on architectural details tend to support the hypothesis that detail is an important part of preferences for buildings. Experiments in which facades were created with varying degrees of silhouette complexity, facade articulation, and surface detailing showed that the largest effects on preference were obtained by adding detail to the surface. Changes to the complexity of the silhouette were less important, and facade articulation was least influential (Groat, 1989; Stamps, 2000). However, the building silhouette is a distinctly important feature because the outline of the roof is critical to image recognition. Complexity in silhouettes can be determined from objective geometrical properties of the architectural shape, such as the number

of turns and angles in the silhouette that contribute to the pattern and complexity (Hedman, 1984; Stamps, 2000).

Repetition and pattern can also contribute to complexity and coherence. Visual information, which occurs throughout the street at a relatively constant rate in a variety of building styles, creates a pattern that dominates randomness to become a whole. If a building does not relate to adjacent buildings, the cause is usually proportion and pattern inconsistency (Smith, 2003). Pattern is particularly important because the mind creates order from complexity by subconsciously creating patterns from the varied elements (Nelessen, 1994).

Hedman (1984) described how the spacing of buildings establishes a pattern and rhythm by the shadow lines of the spaces between the buildings. Wide buildings lack rhythm and subtract from complexity, while narrow buildings in various arrangements add to complexity (Jacobs & Appleyard, 1987). Nelessen (1994) explained that variations on basic patterns can be created by varied building frontage through building orientation, set back lines, windows, balconies, and lintels. Arnold (1993) explained that landscaping, particularly shade trees, are critical for a sense of visual coherence because buildings today lack complexity in their architecture. Burden (2006) described the benefits of street trees, including:

[Street trees] convert streets, parking and walls into more aesthetically pleasing environments. There are few streetmaking elements that do as much to soften wide, grey visual wastelands created by wide streets, parking lots and massive, but sometimes necessary, blank walls than trees. (p. 7)

Jacobs (1993) referred to the complexity of the light and shadow patterns created by the branches and leaves of street trees on the walls and sidewalks. He also mentioned the need for many different surfaces where light and shadow patterns are constantly moving.

Signage and street furniture are also sources of complexity. Most people prefer signage that is moderately complex, rather than highly complex. Too much variation in location, shape,

color, direction, and lettering style creates chaos and confusion for most viewers (Nasar, 1987). Street lights, fountains, benches, and public art all add to the mix of complexity, but some consistency in the style is preferred for a more unified and coherent look (Ewing et al., 2005).

### **Imageability**

Imageability is the most important urban design quality for streets because it is influenced by other important urban design qualities such as legibility, enclosure, human scale, linkage, complexity, and transparency. Imageability is reflected in the combined effect of these qualities (Ewing et al., 2005). In *The Image of the City*, Lynch (1960) gave a definition of imageability:

That quality in a physical object which gives it a high probability of evoking a strong image in any given observer. It is that shape, color, or arrangement which facilitates the making of vividly identified, powerfully structured, highly useful mental images of the environment. (p. 9)

Cullen (1961) related imageability to the use of a visual theme that creates a more cohesive sense of place by having all features work together for a total impression and feeling of pleasantness. An important design quality associated with imageability is legibility, which refers to the ability to navigate and understand the spatial structure of a place. Legibility is also related to linkage, another important concept related to imageability. Linkage refers to the visual and physical connections from space to space, building to building, and building to street that can occur longitudinally along a street or laterally across a street.

Features that promote linkage include block length, pedestrian crossings, sight lines, sidewalk connections, and the use of continuous rows of street trees (Ewing et al., 2005). Tree rows can psychologically connect ends of streets, and tree patterns, which reflect building form or geometry, can connect the building to the street (Arnold, 1993).

Building features that contribute to the visual linkages and sense of unity include: window proportions, entryway placements, decorative elements, materials, and silhouette (Hedman,

1984). Features such as entrance canopies and awnings serve to extend and overlap the domains of public spaces and buildings. Building entries that are similar in proportion and character provide linkage and transition between these spaces (Curran, 1983; Hedman, 1984).

Curran (1983) explained that ground treatment can also be a critical factor in the experience of the public area by explicitly marking areas devoted to movement. Patterns organize, link, and subdivide spaces and encourage movement by enhancing visual appeal and apparent distance. Rhythm and repetition in the pattern also helps discern distance and link areas. With curbs, material changes, and color patterns to indicate pedestrian zones, people are more likely to walk in clearly marked areas (Orr, 1985).

Cullen (1961) showed that landmarks also contribute to image and a sense of place that inspires people to be in the space. These focal points or landmarks, such as sculpture, public art, or towers of buildings, are termination points and spatial organizing and wayfinding devices, and they can be used for closure of long linear areas. They also give meaning to a space through symbolism associated with events, values, and ideas that are important to the community (Curran, 1983).

Two concepts are important for using the urban design qualities and associated physical features for developing walkable streets. One concept is the ability to define and measure the features and the other concept is the users' perception of the value of the features for walkability. These concepts are formally studied as environmental aesthetics or visual quality.

### **Study of Environmental Aesthetics**

The study of the visual quality of the environment is important for designers to develop design standards and codes, and for policymakers to establish design policy recommendations. Courts and legislatures also use study results to help enforce or create laws based on the visual quality of the environment (Ataov, 1998).

Despite conventional wisdom (i.e., beauty is in the eye of the beholder), research has confirmed common architectural preferences among the public that helps to delineate a theoretical framework and definition for urban design aesthetics (Ataov, 1998). Psychologists have described and operationalized this as “aesthetic response”, which is defined as favorable emotional appraisals or evaluations of the environment (Ulrich, 1983). The aesthetic response results from the interaction between the user and the environment. It can vary with personality, expectations, and social and cultural experience, but commonalities occur across individuals (Nasar, 1994; Ulrich, 1983).

The study of environmental aesthetics examines how the emotional response of people to the visual quality of the environment affects their spatial behaviors. The aesthetic qualities of the environment can evoke emotions and feelings such as pleasure, relaxation, excitement, and fear. People will act differently (their aesthetic response) based on favorable or unfavorable emotions about the environment (Ataov, 1998; Nasar, 1997).

The relationship between building properties and aesthetic response is described as follows: The user has certain perceptions of building attributes. These perceptions lead to emotional reactions (affect) and judgments (cognition), which together lead to affective appraisals and connotative meanings, which in turn lead to aesthetic response and spatial behavior (Nasar, 1994; Ulrich, 1983).

### **Measurable vs. Experiential Qualities**

Porteous (1996) explained that the degree of aesthetic response or delight that an urban dweller might experience depends on some basic aesthetic qualities and the artistic manipulation and coordination of those qualities. Researchers have shown that the basic aesthetic qualities can be separated into two categories: the experiential qualities and the physical qualities (Ataov,

1998; Lang, 1987; Porteous, 1996; Purcell, 1986). The physical qualities are the tangible, measurable qualities that collectively contribute to the intangible, experiential qualities that affect environmental preferences. Measurable physical qualities include formal design elements, such as scale, mass, pattern, proportion, line, form, texture, rhythm, and color. The experiential qualities include the urban design qualities of imageability, complexity, coherence, transparency, and enclosure (Ataov, 1998; Kaplan & Kaplan, 1989; Lang, 1987; Porteous, 1996; Purcell, 1986).

### **Human Response and Environmental Aesthetics**

Extensive research has been conducted on the relationship between environmental features and the way in which users respond to those features. Research has centered on three issues: (a) visual features and the perceptual and cognitive processes by which users acquire, organize, and remember these features; (b) visual features and human reactions to them, such as emotional response and evaluation (affective appraisal); and (c) the connection between the two (Ataov, 1998; Downs & Stea, 1973; Lang, 1987; Moore, 1979; Nasar, 1997; Ward & Russell, 1981; Zube, Sell, & Taylor, 1982). Studies have attempted to identify and specify the design details and spatial configurations that contribute to qualities such as complexity, coherence, and imageability. In addition studies have also tried to establish the relationship between the design details and spatial configuration and emotion, meaning, and the environment (Ataov 1998; Berlyne, 1971; Kaplan & Kaplan, 1998; Lang, 1987; Wohlwill, 1976).

### **Research Categories and Models**

Research categories and models have been developed to explain the relationship between the responses of the user and the environmental features. While agreement exists on the models, different researchers divide them into different categories (Lang, 1987; Moore, 1979; Zube et al.,

1982). Three of these categories and the models within them are pertinent to the study of the environmental design features of a walkable urban street: the Objective Relational Category, the Subjective Relational Category, and the Formal Aesthetics Category.

Ataov (1998) offered these descriptions of the three categories. The Objective Relational category consists of models that focus on the objective analysis (measurement) of the environment and does not consider cognitive processing. These models deal with formal aesthetic features that translate into formats applied to design problems, such as guidelines. The Subjective Relational category emphasizes cognitive processing and subjective meanings that people derive from the environment. The Formal Aesthetic category combines the models of the first two categories and is concerned with how the structural aspects or patterns of the built environment affect people's feelings rather than the purpose they serve or the meanings they provide. The models within each category are described below.

### **Objective Relational Category**

The Objective Relational category has two models concerned with identifying aesthetic qualities or elements that can be measured or objectively presented (Appleton, 1975; Gibson, 1979; Ulrich, 1983). The first objective ecological model stresses design, and it explains how people perceive the environment in terms of formal artistic qualities, such as patterns and pattern contrast from line, form, color, and texture (Ataov, 1998).

This model is important for the study of a walkable urban street when investigating the relationship between design features and the perceived purpose or walkability of the street. For example, the details of architecture which create line, form, texture, proportions, rhythms, scale, and color make up the attributes of complexity and imageability in an environment. These attributes are related to perceptions and feelings, such as satisfaction, pleasure, excitement, and

calmness (Ataov, 1998). Lang (1987) considered the features of the built environment that can be measured to include shapes, proportions, rhythms, scale, color, shadowing, and degree of complexity.

The second objective ecological model generally focuses on the relationship between the physical attributes of an environment, the information gleaned (such as the purpose) from the attributes, and the emotional reaction to them. These models assume that the value of an environment is inherent and external to the individual and can be perceived without cognitive processing (Appleton, 1975; Gibson, 1979; Ulrich, 1983).

### **Subjective Relational Category**

The subjective ecological models are concerned with how the structural aspects or patterns, such as shapes, proportions, rhythms, scale, and color of the built environment, affect people's feelings (particularly pleasure) rather than the purpose they serve. The three most important models in the Subjective Relational category concentrate on how environmental patterns or structures affect emotional appraisals of the environment. The first model proposes that humans prefer environments that provide some advantage for survival, and it highlights the importance of availability of information through four main environmental components: complexity, coherence, legibility, and mystery (Kaplan & Kaplan, 1998). The second model represents a subjective approach to understanding environmental attributes and affective responses that are generally based on the assumption that affective responses occur after a learning process (Ataov, 1998). Ataov (1998) explained that an environment that fits existing knowledge is familiar, and while small differences to existing knowledge enhance affinity and preference, large differences produce high levels of preference and increased interest. The third model assumes that people's experiences, values, lifestyles, cultures, and subcultures may influence responses to the

environment, and through experience people learn meanings that are associated with certain environments (Kaplan, Kaplan & Wendt, 1972; Lang, 1987; Nasar, 1997).

The study of architectural preferences, perceptions, and feelings among the public helps to define urban design aesthetics and provides the basis for measurement of aesthetics. The ability to measure aesthetics based on public preferences is an important concept because it provides an empirical foundation for the use of aesthetic codes to control the appearance of the environment.

### **Urban Design Standards and Codes**

The idea that preferences for physical design and aesthetic qualities can be quantified and measured suggests that codes and ordinances designed to control quality and aesthetics can enhance the quality of the built environment. Recent research has centered on the public appearance and “functional fit” of buildings. Research has also focused on the control of visual character for the public good through the use of design controls such as design guidelines, codes, and design review boards (Nasar, 1994; Ulrich, 1983). Designers, policymakers, and the public agree that controlling building appearance is important. More recently, the courts support this view, holding that aesthetics alone is an adequate basis for design controls (Nasar, 1994).

### **Describing Physical Features in Design Standards and Codes**

Studies on the relationship between preferences and physical features can be used to generate architectural standards. However, a key concern is the ability to objectively measure the physical features. In *Psychology and the Aesthetics of the Built Environment*, Stamps (2000) argued that the experience of different intensities of preference or pleasure in the built environment can be expressed as objective measures in terms of materials and geometric relationships or locations in three-dimensional spaces. He discussed techniques that replace traditional descriptions to reduce the inherent vagueness in urban design standards. For example, the required frequency of a design feature in a specified area replaces the concepts of “character”

and “visual richness”. The required frequency can be expressed as the percentage of a facade covered by elements, making it easy to understand and implement the design principle. The notion of bulk is changed into the concept of the amount of visual area as seen from a specified location. The concept of shape complexity is measured as the number of turns and angles in a silhouette.

The objective measure of architectural detail is possible because they are formed by materials which have dimensions and locations in three-dimensional spaces. Physical details can be described in terms of the materials, the location, and/or any mathematical relationship (such as distance or proportion) that is defined among the locations (Van der Laan, 1983). This concept is particularly important for design codes that regulate the built form, including architectural details and spatial dimensions, such as the Form-Based codes.

### **Key Features of Aesthetic Design Codes**

Watson (2001) explained that aesthetic design codes have certain key elements that distinguish them from other regulatory ordinances and zoning codes. These codes include goals to capture people’s values, lifestyles, cultures, and preferences (a design charrette is used to develop goals), and writing and graphics (illustration) that can be understood by the public including a definition of the design terms.

Duerksen (1992) said that communities should: (a) inventory their resources and carefully identify what is worth protecting, preserving, and replicating; (b) tailor the codes to fit their local situation; (c) develop explicit, detailed review standards and define terms in measurable quantities such as height, bulk, materials, and roof pitch; (d) create a well qualified review board of experts and professionals that is supported by adequate staff resources; (e) use visual aids and

illustrated guides to supplement the written review standards; and (f) integrate the codes with other planning goals and regulations.

### **Aesthetic Codes and Walkable Streets**

The idea of codes and planning for aesthetics has gained some urgency as communities strive to make their towns more liveable and walkable. Several articles have addressed the issue of architectural control through codes and ordinances as a means to create more attractive and functional communities. And more recently, aesthetic codes have become prominent in communities that wish to create aesthetically pleasing, walkable communities and streets (Katz, 2004; Lewis, 2004).

Many communities are moving beyond the concept of design guidelines to aesthetic codes as a legal tool to control the appearance and aesthetic value of new and infill development. The focus has turned from the question of the need for codes to how to develop, write, implement, and enforce codes that are often seen as subjective in nature. A new format for the writing of codes has emerged called Form-Based codes (FBCs). This format relies more on the measurable aspects of the urban environment that are related to aesthetics and walkability (Watson, 2001).

### **Design Codes for Walkable Urban Streets**

Urban design qualities have been presumed to be important to walkability. A recent study by Ewing et al. (2005) on the urban design qualities, which seem to have a significant relationship to walkability, has defined features that can be measured objectively. Because they can be measured objectively, these features can also be described and illustrated in written design codes which are then translated to the built form of the street.

The urban street qualities investigated in the study include imageability, enclosure, human scale, transparency, and complexity. The study led to the development of an illustrated field manual for measuring urban design qualities related to walkability. The manual includes

instructions for rating an urban street for walkability by quantitatively measuring certain elements related to the design qualities. Formal design principles, such as scale, mass, proportion, line, and texture, relate to the design qualities and are associated with the measurable physical features, such as building heights and widths, door and window placement, street and sidewalk widths, architectural detail, and street furniture detail (Clemente et al., n.d.).

The relationship between the design qualities, the physical features of the street, the formal design principle that applies, and the applicable measurement is adapted from Clemente et al. in the following list:

- Quality: Imageability
  - Street Features: courtyards, plazas, parks, landscape features, historic buildings, signs, outdoor dining, non-rectangular shaped buildings
  - Principle: scale, mass, line
  - Quantifiable Element: building shape-silhouette, occurrence of courtyards, plazas, parks, signs, dining, landscape features per linear unit of street
- Quality: Enclosure
  - Street Features: distance of sight lines, proportion of continuous street wall (building façade), visible sky, awnings, building height, street trees, street lights
  - Principle: scale, mass, proportion, line
  - Quantifiable Element: wall height and width in relation to street/sidewalk width, street tree and pedestrian light height, awning/overhead height and depth
- Quality: Human Scale
  - Street Features: buildings, articulation of building details, windows, doors, building height, planters, street furniture, street trees, sight lines, street width, sidewalk width
  - Principle: scale, mass, proportion, line, texture
  - Quantifiable Element: building height, percent pavement texture, street tree height, window, door and wall percentages, proportions and heights, furniture and planter percentages and dimensions
- Quality: Transparency
  - Street Features: windows, doors, street wall, mid-block passages
  - Principle: proportion, line
  - Quantifiable Element: proportion of windows to street wall, number of doors visible, occurrence per linear unit of windows, doors, and passages

- Quality: Complexity
  - Street Features: number of buildings, building projections, dominant and accent colors, window detail, building and paving materials, building setbacks, outdoor dining, public art
  - Principle: scale, mass, proportion, line, texture
  - Quantifiable Element: percentage of colors, building projections, door visibility, Building age, window proportions/ mullions, percentage of building and paving materials, depth of setbacks and occurrence/linear unit of dining and public art

The concept that quantifiable features are associated with design qualities related to walkability is particularly important for aesthetic codes, such as Form-Based codes. These aesthetic codes regulate the form or look of a community or street with the goal of making that street or community more walkable.

### **Form-Based Codes**

The term “Form-Based codes” is a relatively new term for codes that are based on form rather than use. Although the term is new, the concept has been around for a while under various names, such as performance zoning and district-based zoning (Lewis, 2004). The approach was first applied in Seaside, a new urbanism community in Florida’s Panhandle, about 20 years ago by Duany, Plater-Zyberk & Company (DPZ), a planning firm from Miami. The DPZ firm continued to refine and adapt the method for a new planned unit development, The Kentlands, in Gaithersburg, Maryland, and ultimately for more than 200 new and existing communities (Katz, 2004; Lewis, 2004). Petaluma, California, was the first city in the nation to formally write and adopt Form-Based codes in 2003 and Columbia Pike, in Arlington County Virginia, recently adopted FBCs specifically to support a pedestrian-oriented development (Katz 2004).

The concept and structure of FBCs originated from SmartCodes, a template that was derived from Smart Growth principles developed by DPZ and licensed by the Municipal Code Corporation in Tallahassee, Florida (Katz, 2004). The California State Assembly recently passed

Assembly Bill 1268, which specifically enables the practice of Form-Based development regulation in California, and the Assembly has endorsed Form-Based codes in its general plan guidelines, referring to Form-Based codes as a “useful implementation measure for achieving certain general plan goals, such as walkable neighborhoods and mixed-use and transit-oriented development” (Katz, 2004, p. 21).

Katz (2004) explained that while conventional zoning controls land use and density, FBCs emphasize form and scale of the street and public realm, regulating the form of the built environment. The intent of the code is to create a predictable public realm by controlling physical form through city or county regulations. Instead of form following function, it is function following form, which allows for multiple uses for one space. The form, the buildings, and the configuration of the street remain the same, but the use changes over time. Although the use is regulated in most codes, it is secondary to the regulation of the built form (Katz, 2004; Pierce, 2003).

The code regulates the form of the buildings, including items such as the porch, stoops, colonnades, awnings, balconies or bay windows, and shop-front windows. The configuration (the spatial definition) of the street and sidewalk is also regulated by the code. The intent is to be prescriptive and enable a predictable and stable physical environment (Katz, 2004).

The codes start with a community visioning process to develop a “consensus vision” which is conveyed through illustrative graphics. Physical characteristics of buildings are typically summarized as standards that establish maximum and minimum building heights, placement of structures in relation to fronting streets, building elements such as doors, windows, and porches, and configuration of spaces such as entrances, parking, yards, and courtyards. Codes may also

include standards for a range of street types and additional architectural standards for more control over the appearance of buildings (Katz, 2004; Pierce, 2003).

Important concepts of FBCs include: achieving a more predictable built result; emphasizing building form and typology; encouraging public participation; motivating multiple property owners to develop independently yet operate within a communally agreed-upon vision; promoting mixed-use; advocating infill that is compatible with existing structures; creating short, concise, visual, and readable codes that are easy for citizens to understand; and requiring less oversight by review boards. The primary purpose is shaping a high quality, community centered, walkable public realm, particularly in the design of public buildings, streetscapes, and public squares (Katz, 2004; Lewis, 2004).

### **Summary**

While research has shown a relationship between physical activity and health, no study has shown a direct relationship between physical activity, physical health, and characteristics of the built environment. The built environment seemingly influences utilitarian physical activity (commute by foot) through proximity of destinations, linkage of path network, quality of the path context, and availability of motorized transport. Urban sprawl is often linked to poor health because the characteristics of sprawl, such as distance to destinations and connectivity of streets, appear to negatively impact the ability to be physically active.

Other environmental determinants of walking include weather, topography, safety, and aesthetics. The least studied of these elements is aesthetics. Little is known about the effects of the street level design features or the relative importance of the visual details and landscape features on the desirability of places for walking. Some of the factors that contribute to the aesthetic design qualities of the street include building design, landscaping, paving materials, street trees and street furniture, signage, and lighting.

Studies have examined how the emotional response of people to the visual quality (aesthetics) of the environment affects their behaviors. But efforts to measure the effects of particular street level features for walkability have been difficult due to difficulties with the objective measurement and quantifying of the features. The objective measurement of architectural detail seems to be the most promising because the details and elements are formed by materials which have dimensions and locations in three-dimensional spaces.

A recent study by Ewing et al. (2005) looked at urban design qualities that are presumed to be related to walkability including: imageability, enclosure, human scale, transparency, and complexity. Each of these qualities is linked with certain built features in the environment that can be counted and objectively measured. The idea that physical design and aesthetic qualities can be measured is an important concept related to codes and ordinances designed to control quality and aesthetics. Form-Based codes, a new type of code based on form and aesthetics, rather than use, is currently being used to shape a walkable public realm by regulating the physical form of public buildings, streetscapes, and public squares.

## CHAPTER 3 MATERIALS AND METHODS

### **Information Sources and Assessment Tools**

Data for my study were collected from several different sources in three phases. Phase I was an audit of urban streets where development of the street was regulated through the use of Form-Based codes. Phase I also included an audit of historic urban streets recognized for being walkable. Phase II was an interview survey of users (business owners) who had businesses on the audited streets. Phase III was a review and summary of regulated features in written Form-Based codes from 30 communities.

The urban design quality (UDQ) models and the perceptual quality score sheet that were used as research tools in my study were obtained from a recent report and field manual prepared by Reid Ewing and colleagues for the Active Living Research Program of the Robert Wood Johnson Foundation.

#### **Field Manual and Score Sheet (Audit Instrument)**

The field manual and score sheet were prepared by a team of researchers: Otto Clemente and Reid Ewing from the University of Maryland, Susan Handy and Emily Winston from the University of California at Davis, and Russ Brownson from Saint Louis University. The field manual, *Measuring Urban Design Qualities: An Illustrated Field Manual* (Clemente et al., n.d.) includes an illustrated guide and score sheet. The field manual and score sheet were developed as an audit instrument to describe and quantify several key urban design qualities that appear to have a relationship to walkability and also have the potential to be measured objectively (Clemente et al., n.d.). The conceptual framework and methodology for developing the field manual and score sheet were described by the authors in a final report titled *Identifying and Measuring Urban Design Qualities Related to Walkability, Final Report* (Ewing et al., 2005).

The primary motivation was to develop a test instrument to be used for additional research to assess the urban design qualities that have the greatest potential to describe or explain the design features of a walkable urban street. A short summary of the methodology is as follows:

- recruit an expert panel
- develop a list of perceptual urban design qualities through literature review
- determine if they are related to walkability
- develop a list of features (physical characteristics) through literature review and expert opinion
- link them to one or more of the urban design qualities (model building)
- determine if they could be objectively measured (validate the features)
- develop an audit instrument using the validated urban design quality models

The Ewing team developed operational definitions and measurement protocols for eight urban design qualities derived from the literature. The team then listed 106 small-scale design features hypothesized to have a relationship to walkability. These features were linked to the eight urban design qualities to develop urban design quality (UDQ) models. Nineteen of the 106 hypothesized features were validated by the Ewing team as having a statistically significant relationship to walkability. The UDQ models with validated features--transparency, enclosure, human scale, complexity, and imageability--were used to create the score sheet, which is the audit instrument for this study.

Throughout my study, reference will be made to two sets of design features: hypothesized features that were validated and used in the audit are referred to as “validated features”; hypothesized features that were not validated and not used in the audit are referred to as “non-validated features.” The difference between the features is an important distinction, because my study considers validated and non-validated features separately in both the review of the codes and the user interviews. The score sheet from the Clemente et al.’s (n.d.) *Field Manual* is simply referred to as the “audit.”

## **Phase I: Walkable Street Surveys**

Ten communities were selected for site visits to evaluate a street using the audit. Five of the 10 communities were chosen from 30 communities that had written and used Form-Based codes for development. The other five were chosen from a list of communities in California with historic streets that have been designated as “walkable.” Fourteen streets (seven historic and seven FBC streets) within the 10 communities were selected for the audit.

### **Selecting Communities for Survey**

The Form-Based code communities were selected primarily on the extent of implementation of the FBCs since they were formally adopted by the community. Most of the Form-Based codes were written between 2002 and 2007 and they were so recently adopted by the communities that no design or construction had been implemented. The level of implementation in each community was determined by contacting the planning department by telephone. Only those communities that had new construction (based on the FBC) on a minimum of one block of a street or corridor were considered for a site visit.

The seven walkable communities with historic downtown streets were chosen from a list of walkable California communities developed by Walkable Communities Inc., a nationally recognized organization established by Dan Burden. Burden is a well-regarded expert and consultant in walkable community design who has worked in more than 1,200 communities in North America (retrieved April 3, 2006, <http://www.walkable.org/article6.htm> ). In addition to the community being designated “walkable,” they were also required to have a historic downtown street that was recognized for its walkability.

The other consideration for all 10 communities was the location. After considering California and Florida as potential study areas, the San Francisco Bay area presented the most possibilities for case studies in the smallest geographic area. The communities were chosen for

their proximity so that certain environmental conditions, such as weather and vegetation (landscape plants and street trees), would be similar for the communities. The communities were also selected for similar demographics, population size, and land size. A map of the San Francisco Bay area (Figure 3-1) shows the geographic location of the cities. The 10 communities included:

- Mountain View
- Petaluma
- Livermore
- Gilroy
- Hercules
- Palo Alto
- Healdsburg
- Santa Cruz
- Los Gatos
- Cotati

Two of the FBC communities, Livermore and Gilroy, had two different types of Form-Based code streets. The streets were either all new construction, including buildings and streetscape, or streets that had maintained the historic buildings but significantly redesigned the street. Two audits were done in each city, one for each of the different FBC streets. Mountain View had one historic street that had been extended through the use of codes which was audited as two separate streets; an historic street and a FBC street. Petaluma had both historic streets and streets built from Form-Based codes. The communities with historic downtown streets and FBC streets used for the audit included:

- Historic Streets
  - Mountain View
  - Petaluma
  - Cotati
  - Palo Alto
  - Healdsburg
  - Santa Cruz
  - Los Gatos

- Form-Based Code Streets
  - Mountain View
  - Petaluma
  - Livermore: new street
  - Livermore: new streetscape
  - Gilroy: new street
  - Gilroy: new streetscape
  - Hercules

A segment of street was evaluated in each community using the audit and following the procedure outlined in the Clemente et al. (n.d.) field manual. Each audit took approximately two to three hours, and included recording counts and percentages and photo-documenting the street environment. Every effort was made to evaluate each street at approximately the same time of day during the course of two weeks. Photos were taken at locations that best illustrated the urban design qualities that were on the audit. The photos included in the field manual were used as guides or examples of the types of scenes to be photographed. No protocol was developed for taking photos as they were not intended to be used for audit purposes, and they appear in the study only for illustration. The recorded counts and percentages were converted to numerical scores for each of the urban design quality models using the protocol (multipliers and constant) on the score sheet (each score is the average for a one block length). A score for each of the urban design qualities--imageability, enclosure, human scale, transparency, and complexity--were recorded on each audit score sheet. The scores correspond to the explanatory potential of that UDQ model for a walkable urban street. In other words, the highest score represents the urban design quality that best explains or describes the features that make that particular urban street a walkable, pedestrian-oriented environment.

### **Phase II: User Interview**

The second step of data collection was an interview with seven merchants/business owners who have businesses along two streets that were audited in Phase I. The purpose of the interview

was to solicit their opinions, as users of the street, about features they believe create a pedestrian-oriented street. The features they cited were compared with the validated and non-validated features and the features regulated in the FBCs.

A matrix of the hypothesized (validated and non-validated) features was adapted from Ewing et al. (2005) *Identifying and Measuring Urban Design Qualities Related to Walkability, Final Report* (Appendix 4, p. 68) for use in Phases II and III. The matrix was used as a tool to screen and record the types of physical features cited by the interviewees and regulated in the design standards of each of the 30 Form-Based codes. As stated, the UDQ *Final Report* listed 106 hypothesized features; however, the matrix for this study was reduced to 76 of the 106 hypothesized features. Because codes are a description of the regulated built elements, only those features associated with the built elements were retained for the matrix. Features that concern pedestrians and vehicular traffic (non-built elements), such as number of pedestrians, number of people seated, and noise level, were eliminated in the matrix.

### **Interview Questions**

The urban design quality models in the audit were used to develop the interview. The description of each of the five different UDQ models (transparency, enclosure, human scale, complexity, and imageability) was used to generate two or three questions designed to help the participant think about and describe the different physical features that make the street walkable.

Petaluma was chosen as the site for the interviews because the city was an early adopter of FBCs (2003), and the city has the greatest number of blocks built from the FBCs. The city also has a thriving downtown historic district with several walkable streets. One of each type of street, historic (Kentucky Street) and FBC (2<sup>nd</sup> Street), was audited and used for the interviews.

Potential interviewees were located by accessing the Petaluma Downtown Association website (<http://www.petalumadowntown.com>), which includes a list of retail merchants in Petaluma with their address and phone number. The executive director of the Downtown Association was contacted by phone and e-mail to discuss the reason for selecting Petaluma as a case study, the intent of the study, and the need for volunteer participants. The director sent an introductory e-mail describing the study to the business owners who are members of the association. This step was followed by a personal phone call to 13 merchants with businesses located either on Kentucky Street (historic) or 2<sup>nd</sup> Street (FBC street). Eight of the business owners agreed to be interviewed. Interview times and dates were arranged, and the participants were interviewed over a period of two days. A total of seven people were interviewed (two were interviewed at the same time and the eighth participant was unable to interview due to a fire in an adjacent business), for a total of six transcripts. Each interview lasted approximately 45 to 60 minutes and the interviews took place either at their business or at an eating establishment on the same street as their shop. The interviews were recorded using an Olympus VN-4100/VN-4100PC Digital Voice Recorder and transferred to a PC for transcription using the Olympus Digital Wave Player software program.

The opening statements of the interview informed the participants that the interview questions would require them to think about what they observe as they walk down the sidewalk, and then offer their opinion about what they see and experience. They were told that the street refers to the space from building front to building front, which includes the building facade, the sidewalks, the road, and all features between the buildings. They were also informed that the survey concentrates on the visual aspects of the street environment and how what they observe

might affect how they feel while walking on the sidewalk. In other words, what do they see as they look down the street that makes them want to walk down the sidewalk and be on the street?

All features cited by the participants were recorded and a list of the features listed in the Clemente et al. (n.d.) *UDQ Final Report* was used to analyze the comments of the interviewees. The list was used to determine which features cited by the users matched the features regulated in the FBCs and the features on the audit. The comments were also reviewed to determine the features cited most often by the users and they were compared with the results from Phases I and III. Selected comments from the participants were used throughout the discussion to illustrate the value of the different UDQ models from the perspective of the user. The qualitative assessment by the users is important to the discussion of the use of FBCs to develop walkable urban streets. Their comments help determine the number and type of built features that should be regulated in the codes to create a street that will be used.

### **Phase III: Form-Based Codes Assessment**

The Form-Based codes used in the assessment (Table 3-1) were downloaded from official city websites. Codes are generally listed under several different names, such as Form-Based codes, Specific Plans, Precise Plans, Downtown Development Plans, or District Master Plans. The plans typically have the Form-Based codes embedded as a chapter in the plan. All Form-Based codes include a regulating plan, building form standards, and public space/street standards. Some codes also include a set of architectural standards and a set of landscape standards. The codes used in this study were required to meet several criteria and there were two limiting factors: (a) availability of the codes--Form-Based coding is a relatively new code concept and a limited number of communities have used Form-Based codes; and (b) Because this study focused on small-scale urban details, all codes chosen for review had to include architectural standards. A few of the codes that were reviewed were in the first public draft

format. Although they are complete, it is possible that subsequent revisions or addendums could alter the codes. The state of California and design firms in California have been the most progressive in the writing and use of Form-Based codes; therefore, 23 of the 30 codes reviewed for the study are from communities in California. The communities vary somewhat in demographics and size, but they are generally mid-size to small communities located on the periphery of large cities.

Each Form-Based code was screened using the hypothesized (validated and non-validated) feature matrix to determine the number and type of built features regulated in the codes. Several data sets were produced: (a) the number and percent of codes in which each feature was regulated; (b) the average number and percent of validated audit features regulated in each code; and (c) the average number and percent of non-validated features regulated in each code.

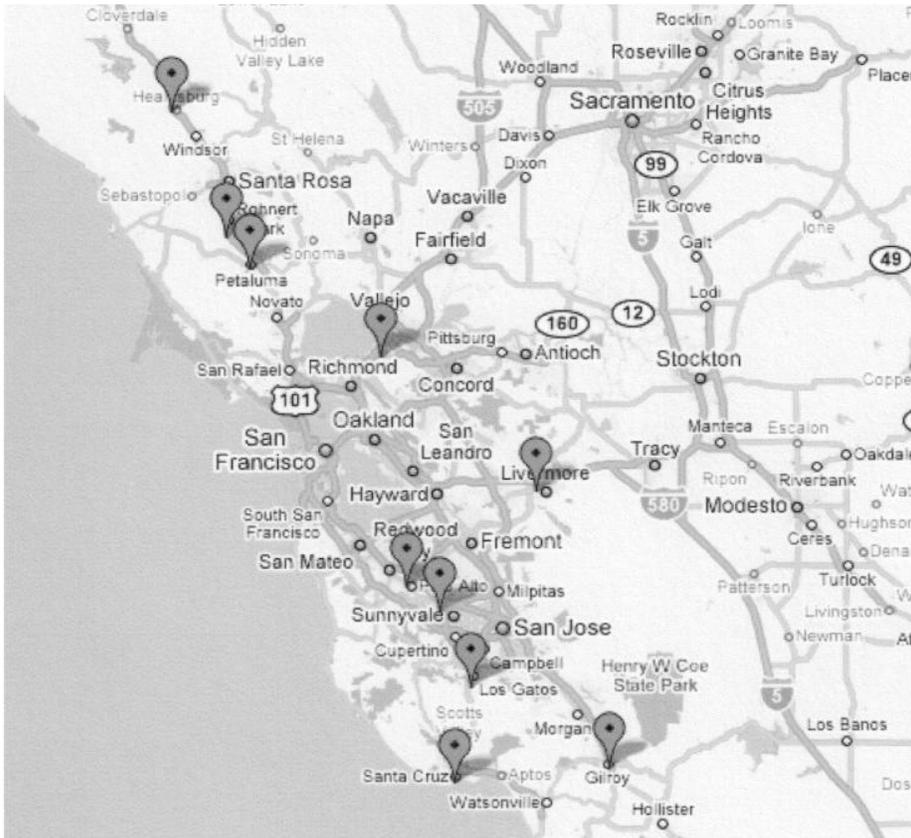


Figure 3-1. Map of surveyed communities.

Table 3-1. Form-Based Codes: city, state and title

City, State	Code Title
Arlington, VA	Arlington/Columbia Pike FBC
Azusa, CA	Monrovia Nursery Specific Plan (residential)
Benicia, CA	Downtown Mixed Use Master Plan
Benicia, CA	Lower Arsenal Specific Plan
Bloomington , IL	Form-Based Code, Section 44.6-26
Brentwood, CA	Downtown Specific Plan
Burlingame, CA	North Burlingame/Rollins Area Specific Plan
Cape Coral, FL	Cape Coral Downtown Master Plan
Cotati, CA	Downtown Specific Plan
Farmers Branch, TX	Form-Based Code: Station Area (TOD)
Fort Bragg, CA	City of Fort Bragg Design Guidelines
Gilroy, CA	Downtown Gilroy Specific Plan
Hercules, CA	Central Hercules Plan
Livermore, CA	Downtown Specific Plan
Montclair, CA	North Montclair Downtown Specific Plan
Mountain View, CA	Downtown Specific Plan
Pasadena, CA	Central District Specific Plan
Paso Robles, CA	The Olsen/Beechwood Specific Plan
Petaluma, CA	Central Petaluma Specific Plan
Pleasant Hill, CA	Pleasant Hill BART Station (TOD)
Redwood City, CA	Downtown Precise Plan
Riverside, CA	Downtown Specific Plan
San Luis Obispo	Margarita Area Specific Plan (TOD)
Santa Clarita, CA	Downtown Newhall Specific Plan
Santa Rosa, CA	Downtown Station Area Specific Plan
Ventura, CA	Downtown Specific Plan
Whittier, CA	Uptown Whittier Specific Plan
Winter Springs, FL	Town Center District Code
Woodford County, KT	The New Urban Code for Woodford County (residential)

## CHAPTER 4 RESULTS

### **Data Collection**

The intent of the Phase I audit of the historic walkable streets was to provide an initial stratification of the urban design qualities to create a framework on which to organize and investigate the research question. The audit of the FBC streets was then conducted to compare the stratification of the UDQ models of FBC streets to the stratification of the UDQ models of the historic streets. This comparison served two purposes: (a) to determine if the streets shared similar urban design features and qualities, and if they did, (b) to determine if the features of the UDQ models of the audit provided a reasonable framework for studying the potential of FBCs to create walkable streets.

A comparison of the audit scores (Table 4-1) showed the same stratification of the UDQ models for the FBC streets and the historic streets. This similarity suggests that the codes are regulating the same features found on historic walkable streets, which implies that FBCs have the potential to create walkable streets comparable to historic walkable streets. To further investigate the potential of the codes, the Phase II interviews were conducted to learn which features the user perceives to be meaningful for a walkable street versus the features regulated by the codes. The premise is that if the features of value to the user are regulated in the codes, the codes have the potential to create a walkable street from the perspective of the everyday user.

To determine if the typical FBC regulates the features present on the FBC streets (in other words, were the features of the built street a result of the codes), a review of 30 codes was completed in Phase III. The assertion is that if the features are regulated in the code they will appear on the street, and application of the codes will have successfully created a walkable street.

The results for Phase I are presented as a stratification of the UDQs based on the audit scores. The results for Phases II and III are presented in two categories: validated features and non-validated features. The rationale for separating the features was to allow a comparison with the audit UDQ models from Phase I, which include only validated features.

### **Phase I: Walkable Street Surveys**

Audit results from both the historic streets and the FBC streets demonstrate a similar stratification with the models, ordered as follows--from high to low scores: imageability, complexity, human scale, enclosure, and transparency (Table 4-1). The scores, taken individually, have no status; they were simply compared and stratified among themselves.

For both streets, the features of the UDQ model of imageability had either the highest percent or largest quantity, or both, of features on the street, giving the imageability model greater explanatory power to describe a walkable urban street. The parallel stratification of the UDQ models for both types of streets suggests that the streets are at least similar in the validated UDQ features in the audit.

### **Phase II: User Interview**

The initial review of the interview transcripts was conducted to simply tally the total number of features cited by the participants in response to the interview questions (Table 4-2). All features that the participants cited were counted, regardless of whether the feature is on the original list of hypothesized (validated and non-validated) features from the Ewing et al. (2005) *Final Report*.

General trends, which were apparent in the comments of at least 50% of the participants, included features associated with the building façade, such as historic styles, building height, colors, architectural details, awnings, signage, windows, and window displays. Comments also included features in the sidewalk, such as sidewalk width, benches, street trees, planters,

pedestrian lights, tables, and chairs. Other comments were more function-oriented with maintenance, type of shops, and type of parking all in the top 50%. All comments made by all of the participants totaled 51 different features. In addition to commenting on physical features, many of the interview participants spoke of the streets in terms that described their feelings about the streets. Some of the descriptive terms included: comfortable, unique, warm, inviting, eclectic, relaxed, interesting, contained, diverse, complex, charming, having character, pleasing to the eye, lacking in uniformity, cohesive, old school, old fashioned, and cozy.

### **Validated and Non-validated Features Cited by Interview Participants**

The list of features cited by the participants was then compared to the validated and non-validated features. The primary purpose was to show which of the validated and non-validated features were cited most often by the interview participants (Table 4-3). The data were used to develop a stratification of the UDAQ models that could be compared to the models from the audit in Phase I and the models from the code review in Phase III (Table 4-4). If the model stratification--based on the features important to the users--is the same as the model stratification derived from the codes, then some agreement exists between the codes and the users. The codes should therefore have a high potential to create a walkable street from the users' perspective.

The stratification of the models from the interviews does not resemble the stratum of the models from the code review in Phase III (Table 4-5). The lack of similarity indicates that the interview participants are not citing many of the features regulated in the codes, and implies that the codes may not have a high potential to create a street that the users would consider walkable. The potential of the FBCs to create a walkable street based on the users' perspective appears weak because they do not regulate the highest percentage of features in the models that are most important from the users' perspective.

The stratification of the models from the user interviews is more similar to the stratum of the audit models from Phase I (Table 4-6). This means that the users' preference for features is a close match with the features that are present on the historic and FBC streets. A close match seems logical because the streets in the audit were those used daily by the interviewees, so it is likely they would comment on the features they see every day on the streets.

The stratification of the user models also makes sense when the features within each model are considered from a users' perspective. Both the complexity and imageability models have specific features that are much more likely to be noticed and used by the average user, such as building colors, awnings, doors, signs, courtyards, street furniture, outdoor dining, and parked cars. It is therefore likely that these features are remembered and commented on by the users. The features in the enclosure and transparency models are not as likely to be mentioned by the typical user because many are not typically in the common vocabulary of the lay person, such as street wall, enclosed sides or terminated vista. Also, the user may be aware of certain features, but might not mention it in his comments because he does not associate it with the street. For example, when considering the audit feature of "proportion of sky ahead," the user may be very aware that he sees sky ahead, but it is not a part of his perception of the street.

### **Phase III: Form-Based Codes Assessment**

The Form-Based codes were screened to determine the number and percent of validated and non-validated features regulated in an average FBC. A matrix with a list of the features and the 30 codes was used to record the features regulated in the codes.

#### **Validated audit features regulated in Form-Based codes**

The first review of the FBCs considered only the validated features from the matrix. The number and percent of codes that regulate validated features are shown in Table 4-7. For example, building height is the most regulated validated feature, appearing in 29 out of 30 (96%)

of the codes. Table 4-7 was developed to determine if the validated features are regulated with high frequency in the codes. If they are regulated with high frequency, the probability that the application of the codes will create a walkable street may be higher. If not, the possibility that other factors are responsible for creating a walkable street must be considered.

The tally of the validated features was also used to compare the stratification of the models from the FBC review with the stratification of the models from the street audit in Phase I. To develop the stratification, the percent of validated features regulated in the codes for each particular model was used (Table 4-8) to determine the position of that model in the stratum. A code stratum similar to the audit stratum would lend more support to the idea that the codes are regulating the same features that appear on the historic streets.

The stratification of the models (Table 4-9) from the FBCs does not resemble the stratification of the models from the street audits, which implies that the features regulated in the codes are not the same as the features in the audit models. For example, the codes regulate only an average of 2.5 (28%) of the 9 validated features from the imageability audit model, yet all nine features are accounted for in the audit of the FBC streets. The discrepancy between the number of features regulated and the number present on the FBC street presents the question of how features, which are not regulated in the codes, appear on the streets designed by application of the codes. One likely answer is that the features are regulated in the codes, but in a different form or language than the language of the audit. Therefore, when reviewing the codes the features were not read or translated directly as an audit feature. The codes are often written to regulate many specific features or details, whereas the audit features are often more broad in description. For example, a code may not specifically regulate a “long sight line,” which is an audit feature in the enclosure model. But a code will regulate many different features, such as

street trees, building height, and street width that create long sight lines in the built environment. This means that “long sight line” was recorded as present on the FBC street in the audit, but not directly regulated in the codes, implying that other regulated features may be creating enclosure features on the street. Another possibility is that the features on the street are the result of other guidelines and standards. It is also possible the features might have been added to the design by the architect or designer, based on their interpretation of the code, or, they were simply installed by the builders or owners of the buildings along the street.

Since the codes regulate many more features than those in the audit, it was speculated that using the validated features only in the code review may not be an adequate method to determine the model stratification for the codes. Therefore, the non-validated features were considered in the second review with the matrix. The possibility was considered that combinations of the non-validated and validated features regulated in the codes may be creating what is recorded as an audit feature on the FBC streets.

### **Validated plus non-validated features regulated in the Form-Based codes**

The FBCs were then screened to determine which of the non-validated hypothesized features were regulated most often in the FBCs (Table 4-10). The combined numbers of the validated and non-validated features were used to create a new stratification of the models. This new stratification was, as before, compared with the stratification of the models in the street audit (Table 4-11).

Again, the stratification of the models derived from the FBCs does not resemble the stratification of the models from the street audit (Table 4-12), with the exception of the human scale model. The addition of the non-validated features made little difference in the order of the models. The FBCs are on average regulating the smallest percent of features in the models with

the highest score in the street audit, and the largest percent of features in the models with the lowest score in the street audit.

Based on the difference in the model stratification, the potential of the FBCs to create a walkable street appears lacking because the FBCs do not regulate the same percent of features, both validated and non-validated, in each of the audit models. However, it is likely that the discrepancy in the model stratification continues to be due to a difference in the format and language of the codes and the audit.

### **Summary**

The results highlight some of the difficulties in measuring, quantifying, and describing urban design qualities and features that make up a walkable street. No similarity was found in the stratification of the FBC models when compared to the audit or interview models. Based on the lack of similarity, the potential of the FBCs to create a walkable street appears lacking because they do not regulate the same percent of features as the audit models or the same features cited by the users.

Although the stratification of the models from the code review does not show a strong pattern (model order) that would clearly indicate that the FBCs have the potential for creating walkable streets, the comparison of the stratification of the models does present the opportunity to discuss the relationship of the features in the models to the features in the codes, the use of models to evaluate walkable streets, and the value of different features for creating a walkable street.

No final conclusion can be drawn about which models would have the greatest influence on the potential of FBCs to create walkable streets. But the stratification of the audit and user models could be used as a guide to the most important models and type of features to regulate in the codes.

The codes do regulate a high total number of the features: on average 38 of the 76 validated and non-validated features (50%) are regulated in 50 % of the codes, and every feature is regulated in at least one or more of the codes. It may therefore be more useful to consider the total number of features, along with the percent in each UDQ model, to determine the potential of the codes. Certain design features began to emerge as key features based on the audit scores, the frequency with which they are regulated in the FBCs, and the frequency with which they are cited by interview participants. These key features may be important to consider for additional features on an audit for walkable streets.

**Tables 4-1 to 4-12**

Table 4-1. Average audit scores in each UDQ for Historic and FBC Streets

UDQ models	Average scores for Historic Streets	Average scores for FBC Streets
Imageability	5.23	5.03
Complexity	4.37	4.50
Human Scale	4.26	4.13
Enclosure	3.05	2.89
Transparency	2.76	2.86

Table 4-2. Number and percent of design features cited by interview participants

Participants	Design features
6- 100%	Common architectural style (historic buildings), Building colors, Active uses
5- 83%	Benches, Street trees, Memorable architecture (architectural details), Awnings
4- 66%	Maintenance, Distinctive signage, Building signs, Type of shops
3- 50%	Small planters, Pedestrian lights, Common building height, Tables, Chairs, First floor windows, Window displays, Type of parking, Courtyards, Sidewalk width
2- 33%	Outdoor dining, Mid-block passage, Miscellaneous street furniture/items (trash cans, banners railings, umbrellas) Overhangs, Street width, One-way street, Building projections (wall angles, grooves, flat/blank walls), Tree in wells (grates), Plants/landscaping, Long sight lines, Number of people, Vistas/views, Textured street (paving materials), Textured sidewalk (cobblestones/pavers/decking), Landscape features (waterfront/river), Various building ages (new buildings), Directional signage, Moving cars/speed, Midblock crossings, Parks, Clear area in sidewalk
1- 17%	Public art, Concrete street, Recessed doors, Anchors on ends of streets, Terminated vista, Angled corners, Building materials, Loading zones, Curb extensions

Table 4-3. Number and percent of participants who cited validated and non-validated features

Participants	Features
6- 100%	Percent of historic building fronts, Dominant building colors, Accent building colors, Proportion of active uses, Common architectural style, % of historic building fronts
5- 83%	Miscellaneous street items, Memorable architecture, Common tree spacing/type, Trees in wells, Awnings/overhangs, Other street furniture
4- 66%	Buildings with identifiers, Place/building/business signs, Distinctive signage, Common signage
3- 50%	Building height, First floor facade with windows, Small planters, Pedestrian scale street lights, Courtyards, Tables, Seats, Parked cars, Sidewalk width
2- 33%	Long sight lines, Outdoor dining, Parks, Directional signage, Midblock passageways, Street width, Building projections, Various building ages, Sidewalk clear width, Textured sidewalk, Number of paving materials, Moving cars/speed, Midblock crossings, Trees in wells/landscaped beds, Large planters without trees, Landscape features
1-17%	Public art, Visible recessed doors, % of Sky across/ahead, Common building heights, Terminated vista, Number of primary building materials, Curb extensions, Textured street, Building height to street width ratio

Table 4-4. Percent validated and non-validated features cited by participants

UDQ Models	Number of validated and non-validated features	Total number of validated and non-validated features	% of validated and non-validated
Imageability	11	15	73%
Complexity	26	40	65%
Human Scale	21	35	60%
Transparency	8	14	57%
Enclosure	8	17	47%

Table 4-5. Stratification of FBC and interview models

FBC models	Interview models
Transparency	Imageability
Enclosure	Complexity
Human Scale	Human Scale
Complexity	Transparency
Imageability	Enclosure

Table 4-6. Stratification of audit and interview models

Street Audit Models	Interview Models
Imageability	Imageability
Complexity	Complexity
Human Scale	Human Scale
Enclosure	Transparency
Transparency	Enclosure

Table 4-7. Number and percent of FBCs that regulate validated features

Number and %	Validated Feature
29- 96%	Building height
27- 90%	% Buildings with non-rectangular silhouette, First floor facade with windows
25- 83%	Entire facade with windows
24- 80%	Percent of street wall
23- 77%	Visible sets of doors, Common building heights
22- 73%	Common tree spacing/type
19- 63%	Memorable architecture
18- 60%	Pedestrian scale street lights
17- 57%	Buildings with identifiers, Visible recessed doors, Common window proportions
16- 53%	Place/building/business signs
15- 50%	Plazas, Parks, Dominant building colors, Accent building colors
13- 43%	Courtyards, Number of buildings
9- 30%	Percent of historic building fronts, Street connections to elsewhere
8- 27%	Public art
6- 20%	Small planters, Outdoor dining, Miscellaneous street items, Terminated Vista,
5- 17%	Long sight lines, Proportion of active uses
2- 6%	% of Sky across/ahead, Number of buildings with non-rectangular silhouette

Table 4-8. Average percent of validated features regulated in each FBC

UDQ models	Average number of validated features/code	Total number of validated features	Average % of validated features
Transparency	1.8	4	45%
Human Scale	2.4	6	40%
Enclosure	1.0	3	33%
Complexity	1.9	6	32%
Imageability	2.5	9	28%

Table 4-9. Stratification of audit and FBC models (validated features)

UDQ Models from Audit	UDQ Models from FBCs
Imageability	Transparency
Complexity	Human Scale
Human Scale	Enclosure
Enclosure	Complexity
Transparency	Imageability

Table 4-10. Number and percent of FBCs that regulate non-validated features

Number and %	Non-validated features
26- 83%	Parked cars, Awnings/overhangs
25- 83%	Common materials
24- 80%	Arcade, Enclosed sides, Number of land uses
23- 77%	Common setbacks, Building projections
22- 73%	Sidewalk width, Average building setback
21- 70%	Number of primary building materials, Street width
20- 67%	Trees in wells/landscaped beds
19- 63%	Height interruptions, Buffer width
18- 60%	Distinctive signage, Common building masses
17- 57%	Number of trees
16- 53%	Common architectural style, Curb extensions
14- 47%	Median width, Other street furniture
12- 40%	Moving cyclists (bike lanes), Midblock passageways, Landscaped median
11- 37%	Various building ages, Sidewalk clear width
10- 33%	Textured sidewalk, Large planters without trees
9- 30%	Building height to width ratio, Number of paving materials
7- 23%	Textured street
6- 20%	Seats
5- 17%	Common signage, Proportion sidewalk shaded
4- 13%	Landmarks, Moving cars/speed (speed limits), Mid-block crossings
3- 10%	Directional signage
2- 7%	Tables
1- 3%	Traffic signs, Building height to street width ratio, Number of landscape elements, Overhead utilities, Landscape features

Table 4-11. Average percent of validated and non-validated features regulated in each FBC

UDQ Models	Average number of validated and non-validated features	Total number of validated and non-validated features	Average % of validated and non-validated features
Transparency	10.1	14	72%
Enclosure	11.2	17	66%
Human Scale	15	35	43%
Complexity	15.2	40	38%
Imageability	5.7	15	38%

Table 4-12. Stratification of Audit and FBC Models (validated and non-validated features)

Audit models	FBC models
Imageability	Transparency
Complexity	Enclosure
Human Scale	Human Scale
Enclosure	Complexity
Transparency	Imageability

## CHAPTER 5 DISCUSSION

### **Urban Design Quality Models and Form-Based Codes**

The discussion concentrates on the relationship of the UDQ models of the audit to the features that are regulated in the codes and cited by the users. Three concepts are speculative or tentative in nature, and the intent of the discussion is to demonstrate how and why these concepts are proposed. The first concept states: A high total number of regulated features in the codes will increase the probability that combinations of those features will produce the desired audit features on the built street. The second concept states: A high total number of regulated features that are the same features cited by the users will increase the potential of the codes to create a walkable street preferred by the users. The third concept states: A greater percent of regulated features associated with the imageability, complexity, and human scale models will increase the potential of the code to create a walkable urban street. The discussion will consider the UDQ models of imageability, complexity, human scale, enclosure, and transparency. The discussion will also examine the results of the street audit, the perceptions and preferences of the users, the code review, and the expert opinions from the literature review.

#### **Form-Based Codes Format**

Frequent reference is made in the discussion to the Pasadena Central District Specific Plan, 2004 (City of Pasadena, Planning and Development Department, retrieved April 10, 2006, from <http://www.ci.pasadena.ca.us/planning/deptorg/commpng/GenPlan/centdis.asp>) when describing the relationship of an urban design quality or design feature to the codes. The Pasadena plan regulated 57 out of the 76 validated and non-validated features, the second highest of the 30 codes reviewed. The Pasadena plan is also the most comprehensive of the FBCs reviewed. A unique aspect of the plan is the format of the design guidelines. The guidelines describe 15 urban

design concepts/qualities, explain the intent for each (often describing the desired experience), and give recommendations for implementing the features related to that quality. Many of the qualities and concepts are the same or similar to the UDQs that were considered in the Ewing et al. 2005 study, and the format (urban quality, plus intent, plus features) is very similar to the organizational approach of the audit. The format makes it simple for the person using the code to link each feature to a design quality and understand the design intent and benefits of the features to the user.

The discussion also makes frequent reference to the FBCs for Gilroy and Livermore, two cities included in the street audit. These cities consistently scored highest in most of the UDQ models in the audit and among the 30 codes reviewed. They regulated a high number of validated and non-validated features. The Gilroy codes (Downtown Gilroy Specific Plan, 2005, City of Gilroy, retrieved April 12, 2006, from <http://www.ci.gilroy.ca.us/planning/projects.html> ) regulated 63 out of 76 features, and the Livermore codes (Livermore Downtown Specific Plan, 2004, City of Livermore, retrieved April 23, 2006, <http://www.ci.livermore.ca.us/dsp/dsp.html> ) regulated 53 out of 76 features. All the codes on average regulated only 34 features.

### **Perceptions of Users and Experts**

The perceptions and preferences of the users (business owners) are presented through comments from the interview participants from the Downtown Petaluma Business Association. The interview responses refer to Kentucky Street, a historic street in downtown Petaluma, and 2<sup>nd</sup> Street, an FBC street also in downtown Petaluma. The views of the “experts” are expressed by including relevant citations for the literature review.

## Discussion Format

The discussion is organized to review each UDQ model in the following manner:

- **Audit features in the FBCs:** A comparison of the audit features and regulated code features is the basis for explaining why the scores of the FBC streets were similar to the scores of the historic streets even though the codes did not regulate many of the audit features. The comparison is also the basis for explaining the concept of the importance of the UDQs of imageability, complexity and human scale.
- **Regulated features in the FBCs:** All the features regulated in the codes that link to the UDQ models are listed to demonstrate how features regulated in the code could collectively create and be recognized and recorded as an audit feature on the built street. This exercise illustrates the concept that a high number of features regulated in the codes may be important.
- **Proposed features for a street audit:** This portion of the discussion proposes new features that are not currently in the UDQ audit model. The proposals are put forth based on the frequency of regulation in the codes and frequency of comments by the users.
- **Expert and user perspectives:** Includes interview comments and literature citations to illustrate the concept of how regulated features link to features cited by the users, which may increase the potential of the codes to create a street preferred by users.

### Imageability Model

The UDQ model for imageability was found to have the strongest explanatory or descriptive power (highest audit score) in the 14 street surveys. Ewing et al. (2005) wrote that imageability is the most important quality to street design because it is influenced by the other urban design qualities of legibility, enclosure, human scale, linkage, complexity, and transparency, and it is reflected in the composite effect of those qualities. Imageability is described by Ewing et al. (2005):

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. (Appendix 2, p. 40)

Many of the reviewed codes also seek to describe and create high imageability as stated in their goals and objectives. For example, one of the primary goals for the *Downtown Gilroy Specific Plan* (City of Gilroy, 2005) states: “Downtown Gilroy will showcase restored historic

buildings, attractive new buildings, a bustling transit center, new housing, pedestrian-oriented public spaces and amenities, and a new town plaza” (p. 21). Several references in the literature review agree that the quality of being memorable is important. Jacobs (1993) stated that the best streets are those that leave a lasting, strong impression and are easy to remember.

### **Audit Features for Imageability in the FBCs**

The Phase I audit included six features, listed below, for imageability (adapted from: *Measuring Urban Design Qualities Related to Walkability: An Illustrated Field Manual*, Measuring Urban Design Qualities Scoring Sheet, Clemente et al., n.d.). Two original features “number of people” and “noise on the street” was not used for my audit because they are not design features that can be implemented by the codes.

- Number of courtyards, plazas, and parks (both sides, within study area)
- Number of major landscape features (both sides, within study area)
- Proportion of historic building frontage (both sides, within study area)
- Number of buildings with identifiers (both sides, within study area)
- Number of buildings with non-rectangular shapes (both sides, within study area)
- Presence of outdoor dining (your side, within study area)

The audit features for imageability were not regulated in high numbers in the codes. On average, only 2.5 out of a total of nine (28%) of the validated features in the imageability model are regulated in the FBCs. The number and percent of codes that regulate each imageability feature are shown as follows:

- 17 (57%) Number of Buildings with identifiers
- 15 (50%) Plazas, parks
- 13 (43%) Courtyards
- 9 (30%) Proportion of historic building fronts
- 6 (20%) Outdoor dining
- 2 (6%) Number of buildings with non-rectangular shapes
- 1 (3%) Number of major Landscape features

The imageability model in the audit had a higher average score on the historic streets than the FBC streets, with three out of the top five highest scores for imageability on the historic

streets. This is not an unexpected result as the features for imageability are much more likely to be found in greater numbers on a historic street, particularly the proportion of historic building fronts and number of buildings with non-rectangular shapes. The FBC streets in Livermore, Gilroy, and Hercules also scored high in imageability. The codes for two of these communities, Livermore and Gilroy, regulate a high number of imageability features, with five out of the six audit features for Gilroy and four out of the six audit features in the Livermore codes. However, the codes for Hercules regulate only two out of the six audit features in the codes, yet it scored high in the audit.

Several examples might help explain why codes, such as those for Hercules, that do not specifically regulate a high number of imageability audit features would produce streets that score high in imageability. One example is the audit feature of “number of buildings with non-rectangular silhouettes.” Typically, a large number of this type of building can be found on FBC streets. Although the codes do not specify a non-rectangular silhouette, many of them do regulate a great number of architectural details and architectural styles that create a non-rectangular shape when built. Also, many of the streets have existing historic buildings from the 1850s to the 1950s that more typically have an irregular shaped facade. Another example is “number of buildings with identifiers.” The codes do not generally specify how many buildings must have identifiers (signs), but most of them do have detailed sign regulations, stating size, type, materials, and location, that translate in the built environment to signs on nearly all buildings.

These examples demonstrate how a collection of details or features regulated in a code can produce the audit feature on the built street. These examples also show how a design or architectural term in a code, such as parapet or cornice, can be interpreted in different ways and result in the feature being present on the street and recorded on the audit.

## Regulated FBC Features Related to Imageability

Features regulated in the FBCs are linked with an audit feature from the imageability model (in bold) to demonstrate how regulated features can indirectly create features (and UDQs) on the FBC streets. For example, the codes may not specifically state that major landscape features be present on the street, but they might regulate features, such as a landscaped median, raised planters, or minimum size of planters which would be recognized as a major landscape feature and recorded in the audit.

- **Plazas, parks, courtyards** may be regulated in the code through: open public space, fountains, garden walls, fences, courtyard entrances, uses for public space, and landmarks.
- **Number of major landscape features** may be regulated in the codes through: landscaped medians, plant materials, raised planters, minimum footprints for planters, minimum number of trees in a public space, plant size, and terminated vistas.
- **Percent of historic building fronts** may be regulated in the codes through: renovate or reconstruct historic buildings, use common architectural style, details on historic buildings, preserving architectural heritage, and landmarks.
- **Number of buildings with identifiers** may be regulated in the codes through: types, materials, and locations for signs, logos and shapes for wayfinding signs, building signs, and distinctive signage.
- **Number of Buildings with non rectangular shape** may be regulated in the codes through: historic buildings, common architectural style, landmarks, roof lines, building projections, and upper story setbacks.
- **Outdoor dining** may be regulated in the codes as: a list of permitted uses (restaurants and cafes), colonnades, arcades, front porches, street furniture, and tables and seats.

## Proposed Audit Features for Imageability

Two additional features also frequently regulated in the codes-- but not represented in any of the existing audit models-- are proposed to be included in a street audit. The regulated features are linked with a proposed audit feature (in bold) to show how the codes support adding these features to an audit. One important issue to remember throughout the discussion of the features

for UDQs is the ability to measure a particular feature in a quantitative form, such as a count or a percentage. Any new feature that is proposed for a model must meet this criterion to be useful in an audit instrument for walkable street features. The audit item must be written to indicate how the feature will be counted or measured.

- **Memorable Architecture:** Regulated features such as awnings and overhangs, marquees and balconies, front porches, colonnades and arcades, stoops and doors, bay windows, light fixtures, facade composition, detailing, and ornamental relief should be counted in the audit as “number of buildings with facade detail and decorations.”
- **Quality Building Materials:** Regulated features such as wood, stone, brick, tile, transparent glass, plaster, painted signs, cloth/canvas awnings, metal balconies, exposed rafters and beams, moldings, metal downspouts and scuppers should be counted in the audit as “number of buildings with quality materials.”

Memorable architecture is proposed as an audit feature--separate from “non-rectangular buildings” and “historic architecture” --because 63% of the codes specifically regulate architectural details that create memorable architecture and 83% of the interview participants cited architecture is being memorable. The literature also supports memorable architecture as an important quality of walkable streets. By counting buildings with facade detail and decoration, both memorable new buildings and historic buildings can be recorded in the audit. High quality construction material is also a proposed audit feature because many codes emphasize the importance of quality materials and several of the interview participants commented on new, versus old, materials.

### **Expert and User Perspectives**

The literature and user perceptions support many of the imageability features as being important to walkability. The merit of each audit feature is discussed, including relevant comments from the users and citations from the literature review.

## **Historic Buildings and Buildings with Non-rectangular Shapes**

Thirty percent of the codes regulate historic building fronts as an important visual quality. All the interview participants cited historic buildings as important features in the street. One code example is the *Pasadena Central District Specific Plan* (City of Pasadena, 2004), the District Wide Guidelines for Community Character include Guideline CC 5: Recycle Existing Buildings and Landscapes. The intent of the guideline is described as follows: “Existing buildings and landscape elements provide a sense of historical and physical continuity, strengthen the urban fabric, and reinforce the unique qualities of the Central District” (p. 133).

The Pasadena city-wide design criterion includes cultural expression, noting that a community should express local history and culture. Recommendations include: (a) encouraging the recycling of historic or architecturally significant downtown buildings; (b) maintaining the distinguishing qualities and features of historical or architecturally significant buildings; and (c) repairing and retaining original building materials when feasible.

The literature also supports the notion that architecture is important to identity or sense of place. Unwin (2003) in *Analysing Architecture*, declared that “the fundamental motivation of architecture is to identify places” (p. 15), and Stamps (2000) wrote that sense of place (visual character) can be defined by the design features, such as building materials, windows on the building facade, number of floors, and the roof form of buildings. The users agreed. When asked what captures people’s attention most on the historic streets, one interview participant replied, “It’s got to be the old buildings. I think that’s neat. You definitely notice when you have left the old and you are in the new.”

When asked specifically about buildings, one participant noted that the little details of the historic buildings on Kentucky Street were important, “There’s a lot of metal detail on this

building. It was poorly painted, but it still looks nice.” Another participant said, “The ornate trim and sorta the, you know, the moldings and the gingerbread aspect.” Another participant noted the historic architecture (Figure 5-1A) and the variety of colors and different shops, commenting, “It’s unique and exciting . . . but I wish we had more plants. We need more planters and lights on trees.”

One participant stated, “These buildings here [on 2<sup>nd</sup> Street] are absolutely gorgeous and they fit within, I mean, they are new, but they have that kinda old look, you know, the old-fashioned look.” Another participant commented on the same street, “It’s clean, and neat, and new and interesting, I think they did a great job architecturally on everything” (Figure 5-1B). However, the same participant, when asked if there was anything about the look of the building that encouraged people to walk answered, “No, I don’t think so.” But she noted that on other memorable streets history played a role, saying, “There’s some history here [on 2<sup>nd</sup> Street] but they didn’t do a very good job here because they could have done a lot of things. They could have done plaques, just simple things, or put it in the sidewalk, that makes it interesting to people.” Ewing et al. (2005) and Jacobs (1993) both noted that imageability is the quality of a place that makes it memorable and leaves a lasting impression. One participant noted that 2<sup>nd</sup> Street would not make a lasting impression on anyone right now, saying:

I think it has to grow into it. I think it has the right start but it needs more time. Kentucky Street is better because it has the old architectural buildings, here [2<sup>nd</sup> Street] you can still tell it’s a developer’s building. Over time it will probably change. I definitely see the difference between the two streets.

### **Courtyards, Plazas, and Parks**

Courtyards, plazas, and parks are considered as one feature in the audit, and nearly half the interview participants mentioned them in their comments. One interview participant noted that what captured her attention most was the congregation of people in the small courtyard on

Kentucky Street, saying, “People make it inviting there.” Another participant referred to the small courtyard as a breezeway and noted that many people stopped to use the benches and chat (Figure 5-1C).

Fountains are often found in courtyards, and many of the codes recommend them for added character and imageability. The attraction of moving water, both visual and aural, is universal and water encourages passive engagement with the environment for relaxation (Carr, Francis, Rivlin, & Stone, 1992; Marcus & Francis, 1990). One interview participant from 2<sup>nd</sup> Street commented on the courtyard and fountain several times (Figure 5-1D), noting the congregation of people between the two buildings: “We have people who come with their kids and strollers. The fountain that we have out there, if you come on Saturday or Sunday afternoon, you’ll see lots of people congregating around it; there’s no cars; it’s more intimate [feels closed in] and comfortable [in the courtyard].”

### **Number of Buildings with Identifiers**

Distinctive signage and number of buildings with identifiers are regulated in 57% or more of the codes. Distinctive signage is an element that can contribute to the imageability of a street by adding interest. Rapoport (1990) stated that pedestrians require a high level of complexity to hold their interest, noting that elements that hold interest include signs, building details, changing light patterns, and people. Sixty-six percent of the interview participants cited buildings with identifiers as important to a walkable street (Figure 5-2A). Several of the participants who mentioned signage considered it to be a component of the building facade.

One interview participant from the new FBC street (2<sup>nd</sup> Street) noted that signs make a difference: “Ever since I put my blade signs up, I’ve had my ‘I can’t find you calls’ go down 80%. It works, it stands out, it’s a different color, mine’s a different shape, it makes a big

difference, it really does.” One participant commented on the signage on the historic street as having the same shape and same bracket that holds it to the building, yet still appears unique. Nasar (1987) wrote that most people prefer signage that is moderately complex, although too much variation in location, shape, color, direction, and lettering style can create chaos.

Several of the codes include standards for wayfinding elements such as a coordinated system of signs and maps to be included in the street scape. One participant had this comment about the signage on the FBC street:

It’s huge [very important], the signage there is really bad, they’re still working on it, it’s just horrible. The signage was an afterthought and that should be primary. There’s no signage [directional signage] at all, even in the parking structure. There should be a sign that says, “You are here.”

Another participant from the historic street complained that the pedestrian signs in the new FBC district were not “placed to encourage people to walk this way [to the historic streets].”

### **Major Landscape Features, Terminated Vistas, and Landmarks**

Terminated vistas and landmarks are design elements often incorporated at the street ends to achieve enclosure. Ewing et al. (2005) noted that these elements are typically prominent buildings, large monuments, or fountains of a very distinct design that contribute to the imageability of the street. Jacobs (1993) wrote that most great streets have a special feature to mark the beginning and end. These reference points, when well designed, contribute in a significant way to great streets. In Petaluma, 2<sup>nd</sup> Street has a small view of the riverfront (Figure 5-2B), and a terminating historic building, but only one interview participant commented on the river saying, “We do have a lot of foot traffic in this direction, I think it’s because of the river walk. They redid the whole river and made that all cobblestone. I think that really helped people want to walk over there.” Kentucky Street has a terminating view of a wonderful park on a hill, but none of the participants commented on the park. However, one participant commented on the

multi-level Victorian buildings that anchored the ends of the streets and were considered as landmarks. Curran (1983) noted that landmarks, such as towers of buildings, are termination points and spatial organizing and wayfinding devices. These types of landmarks can be used for closure of long linear areas. Figure 5-2C shows the use of a tower on Railroad Avenue, an FBC street in Hercules.

### **Outdoor Dining**

Outdoor dining appears under both imageability and complexity on the audit. The literature typically links outdoor dining more with complexity. However, when asked about memorable streets, one participant commented on the outdoor restaurant seating:

One of the things that is most memorable to me is the, down there on the end of 2<sup>nd</sup> Street, is the wood deck. It's a very visual thing when you see 20 chairs out there and tables. It makes it pop out, you know, umbrellas, the same thing.

Some of the participants remarked on streets in other familiar towns and how pleasant they were, having a wide strip of sidewalk with tables, chairs, and umbrellas. The FBC street surveyed in Mountain View (Figure 5-2D) is an example of a street that specifically had outdoor dining regulated in the codes.

### **Memorable Architecture (Buildings with Facade Detail and Decoration)**

Memorable architecture is a proposed audit feature important to imageability which is also proposed for the human scale model. Citations from the literature and comments from the users make an argument for including memorable architecture as an audit feature. Smith (2003) discussed the qualities of architecture, such as decoration, materials, and morphology that create the synergy or memorable quality of a public space to encourage pedestrians. He explained that the details are important to the visual character and aesthetics, which is important to walkability, because streets are architecture plus space and time. Southworth (2005) stated that varied architecture with small-scale detail contributes to explorability and changing vistas, which are

important attributes to the context of the street. Hedman (1984) noted that building features, such as window proportions, entry placement, decorative elements, style, materials, and silhouette, contribute to a sense of unity and visual linkage. One interview participant agreed, commenting that the shape of the windows is important, particularly bay windows (Figure 5-3A).

Other features of memorable architecture regulated in the codes include building form, such as classical proportioning and symmetrical facades, and architectural details, such as colonnades, columns, arches, piers, and ornamental detailing. When asked how buildings helped create walkable streets, one interview participant noted:

It feels comfortable when you can see things that are coming off the building, like even in architecture where they have on the bottom, instead of a plain straight column, they put a border around them. I think that really adds a lot to it, instead of just having a flat building that has no depth.

### **Quality Construction Materials**

The second proposed audit feature for imageability is “quality construction materials.” Many of the codes regulated the type and quality of building materials, noting that the buildings should be viewed as a long-term civic investment. An example comes from *The Pasadena Central District Specific Plan* (City of Pasadena, 2004), District Wide Guidelines for Building Design, Guideline BD 6 which stated: Encourage High Quality Construction. The intent of the guideline is described as follows:

It is imperative that all buildings are constructed as a long-term addition to the urban fabric. A well-built structure adds value to the Central District. It contributes to the stock of well-crafted buildings, and communicates the significance and enduring quality of the place. (p. 157)

Recommendations include employing durable and high quality materials, particularly at the street level, and encouraging materials that show permanence and quality, such as stone, terra-cotta, tile, metal, brick, and transparent glass. It is also recommended to design architectural features as an integral part of the building rather than those that appear to be “tacked-on” or

artificially thin. One interview participant spoke about the quality of materials used on the new theater facade (Figure 5-3B) visible from 2nd Street: “They put this old art deco style out front, and if they had just spent that same money on something hand painted, something a little less plastic, it would have had more charm.” Stamps (2000) explained that details are related to preferences for buildings, with experts and the public in high agreement over facade details, such as the carvings shown in Figure 5-3C. One participant noted the difference between the new architecture on the FBC street and the old architecture of the historic street:

On Kentucky Street they look different, like different buildings. You can look at the bottom and say, this building is recessed in, it has tiles, the next one is all glass, and the next one, which is part of it, is stone, and you have three totally different looks in one building. On the bottom level you do not see that here [on 2nd Street]. They tried to do it here. We have a different look to some degree because our awnings are different color, and the buildings change color. The bottom looks the same. The upper part they tried to change by a little bit different architecture. We have a different window set-up. They get credit for attempting to do that.

One interview participant did not think there was anything in particular about the buildings on the FBC street that encouraged people to walk, except to note: “It’s pretty, it’s clean, it’s new. All that’s very obvious and the developer that owns these buildings, they are the best in town at maintaining the properties.”

## **Summary**

In summary, on average the codes do not directly regulate a high number of audit features for imageability. However, they do regulate many other architectural details and landscape features that, when present on the built street, result in the features on the audit for imageability. Those codes that did regulate a high number of features related to imageability also had high scores on the audit. Many of the hypothesized non-validated features in the imageability model, which were not included in the audit, such as terminated vistas, landmarks, and distinctive signage, can be linked to the validated audit features. For example “distinctive signage” is often

found on the buildings on the street and is counted in the audit as a “building with identifiers.” Two features proposed to be included as new audit features are “memorable architecture” and “quality construction materials.” Memorable architecture is proposed so that new buildings and historic buildings, which contribute to the visual quality, are recorded in the audit score. The feature of “quality construction materials” also makes it possible to include new buildings in the assessment of the visual quality. Many regulated features in the codes link with and result in the audit features for imageability being present on the street, which suggests that the FBCs have a high potential to create a walkable urban street based on the imageability model.

### **Complexity Model**

The UDQ model of complexity had the second highest descriptive power for a walkable urban street in the street survey. Ewing et al. (2005) wrote that complexity depends on variety, and they described complexity as follows:

Complexity refers to visual richness of a place...depends on the variety of the physical environment, specifically the numbers and kinds of buildings, architectural diversity and ornamentation, landscape elements, street furniture, signage, and human activity.  
(Appendix 2, p. 45)

### **Audit Features for Complexity in the FBCs**

The Phase I audit included five features listed for complexity (adapted from: *Measuring Urban Design Qualities Related to Walkability: An Illustrated Field Manual*, Measuring Urban Design Qualities Scoring Sheet, Clemente et al., n.d.). One original feature, “number of people”, was not used in the audit because it is not a design feature that can be implemented or affected by the codes. The five features are as follows:

- Number of buildings (both sides, within study area)
- Number of basic building colors (both sides, within study area)
- Number of accent colors (both sides, within study area)
- Presence of outdoor dining (both sides, within study area)
- Number of pieces of public art (both sides, within study area)

The audit features for complexity were not regulated in high numbers in the codes. Only building colors is regulated in 15 (50%) of the codes, and outdoor dining is regulated in six codes. On average, 1.9 complexity features out of 6 (32%) are regulated in each code. The number and percent of codes that regulate each complexity features are shown below.

- 15 (50%) Dominant building colors, accent building colors
- 13 (43%) Number of buildings
- 8 (27%) Public art
- 6 (20%) Outdoor dining

The complexity model scored high in the audit of the FBC streets. Three out of the top five highest scores for complexity were on streets built from Form-Based codes. Again, FBC streets in Livermore, Hercules, and Gilroy scored high in this model. The codes for two of these communities, Livermore and Gilroy, regulate a high number of complexity features, with three out of five features for Gilroy and five out of five features for Livermore (as compared to the average of 1.9 out of 6 features regulated). The codes for Hercules do not regulate any of the audit features for complexity. Because the FBCs for Livermore regulate all five of the audit features, it would be reasonable to expect those features to be present on the street, resulting in a high score on the audit. A high score on the audit for Gilroy is also reasonable with three of five features regulated. FBCs for Hercules regulate none of the features, yet Hercules also scored high in “number of buildings” and “number of basic and accent building colors” (Figure 5-4A). However, an explanation exists for this particular discrepancy. The building colors were regulated through a different entity, Community Development and Public Services (CDPS), and were not included in the FBCs.

The total number of buildings was also not included in the codes, however, minimum (16 feet) and maximum (160 feet) building widths were regulated, which indirectly influences the number of buildings per block face. The buildings averaged 45 feet in width, resulting in a high

number of buildings in the audit count. This particular feature was common for all the codes, which typically emphasized narrow building widths and discouraged buildings with long facades and no architectural division.

Outdoor dining was also not regulated in the Hercules codes; however, each building had a small entry courtyard with two or three small tables and a few planters, which made a very inviting outdoor space. The buildings were not fully occupied by the intended businesses at the time of the audit (some were still realtor offices). But the occupants of the buildings were observed eating their lunch and meeting with clients in the courtyards (Figure 5-4B).

### **Regulated FBC Features Related to Complexity**

The features related to complexity, which are regulated in the FBCs, are linked with the audit features (in bold) to show how they indirectly create the audit features in the built environment, and are recognized and recorded as audit features. For example, many codes do not specifically regulate outdoor dining, but they regulate street furniture that can be used for outdoor dining.

- **Number of buildings** may be regulated in the code through: maximum and minimum building widths, space between buildings, distance between doors, pattern of building openings, architectural style, scale and mass to match existing buildings, building type, and building proportions.
- **Number of building colors** may be regulated in the code through: building materials, “in keeping with existing colors”, and style of architecture (historic colors).
- **Outdoor dining** may be regulated in the code through: permitted uses (restaurants and cafes), colonnades, arcades, front porches, type of street furniture, tables, and seats.
- **Number of pieces of public art** may be regulated in the codes through: gateway features, artisan crafted architectural details, landmarks, decorative utilities, street furniture, pavement markings, planters, environmental graphics, ornate street lights, fountains, murals, banners, mosaics, and window displays.

## **Proposed Audit Features for Complexity**

Three non-validated complexity features, building projections, paving materials, and parked cars, are proposed as audit features based on how frequently they were regulated in the codes and cited by interview participants. Parked cars were regulated in 83% of the codes and cited by 50% of the users; building projections appeared in 77% of the codes and were cited by 33% of the users; and paving materials were in 30% of the codes and were cited by 33% of the users. The proposed features are listed with a qualitative description for an audit.

- **Building Projections/Façade Patterns:** Regulated features such as awnings and overhangs, marquees and balconies, front porches, light fixtures, colonnades and arcades, stoops and doors, and bay windows should be counted in the audit as “number of building projections.”
- **Paving materials:** Regulated features such as textured sidewalk, textured street, and clear pedestrian passage should be counted in the audit as “number of different paving materials.”
- **Parking:** Regulated features such as parking structures, parallel parking, diagonal parking, and parking bay types and dimensions should be counted in the audit as “percent of street with parked cars or parking bays.”

## **Expert and User Perspectives**

The literature supports the value of complexity for a walkable urban street. Hedman (1984) stated that for the everyday user, a degree of complexity will renew his interest, but simplicity is also needed for comprehension of the larger space. Ashihara (1970) noted that with increasing complexity of the building form, the exterior space becomes a stronger positive space, and Rapoport (1990) remarked that pedestrians require a high level of complexity which he described as the number of noticeable differences the viewer observes in a defined time period. Rapoport further stated that complexity includes such features as building details, people, surfaces, signs, and changing light patterns.

## **Number of Buildings**

None of the 30 codes reviewed specified a set number of buildings per block, as block lengths vary in different communities. But nearly every code did regulate maximum and minimum building widths, which translate to a maximum and minimum number of buildings per length of block. The literature generally supports the concept of many smaller buildings on the ground floor for interest and complexity. Hedman (1984) stated that the spacing of buildings establishes a pattern and rhythm by the shadow lines between buildings, with narrow buildings generating an irregular but definite rhythm and wide buildings lacking rhythm. Figure 5-4C shows the pattern of buildings in Hercules with approximately a 45 foot width for each building.

## **Building Colors**

Stamps (2000) explained that small-scale ornamentation, such as material, color, and patterning, adds the element of visual texture and richness. He added that public preference is highly correlated with expert judgment with regard to these details of the facade. Seventy percent of the codes regulate primary building materials, including the texture, quality, and color of the materials. One participant commented about Petaluma's 2<sup>nd</sup> Street: "We have buildings that are new, but it's the right colors, [Figure 5-4D]. The architect, whoever did it, did a really good job--the look, and the colors, and everything else." Hedman (1984) wrote that complexity, detail, and color influence the effect of sunlight and shadow. When asked if there was any feature about Kentucky Street that would make people want to walk there, one participant commented, "Certainly the Victorian color scheme of all the buildings is just pleasing. You see buildings that are bright pink and bright blue with all the ornate trim." Another participant, remarking on colors on the same street, had an entirely different perspective: "The earth tones and toned down colors, for me, are very soothing on the visual."

## **Outdoor Dining**

The literature primarily discusses outdoor dining, such as cafes, as a component of complexity, transparency, and human scale. Curran (1983) noted that cafes, with seating next to buildings and extending into spaces, give a supportive transition zone for the main function of walking. Outdoor dining is not a prominent feature on either of the streets used for the interview, but several of the participants commented on outdoor dining. When asked what captures his attention, one interview participant mentioned that when a restaurant changed hands, the new owners put in an outdoor seating area with tables and umbrellas (Figure 5-5A). He stated:

I noticed a difference [that] when they had it and when they didn't, it added a whole other depth, and whole new dimension. I never went to the restaurant before because it never stood out even though I walked by it every day. All of a sudden you see umbrellas and chairs, and it seemed instantly inviting to me.

## **Public Art**

Only 27% of the codes specifically regulate public art, but those that did made it a priority item on the streetscape. For example, Guideline CC 8: District Wide Guidelines for Community Character, of *The City of Pasadena Central District Specific Plan* (City of Pasadena, 2004), stated: Incorporate Civic Art. The intent is stated as: "Civic art provides multiple and layered expressions of local history and culture. It contributes to local identity and the unique qualities of place" (p. 136). When asked if complexity encourages people to walk, one participant gave an enthusiastic reply:

One of the biggest draws is the fountain [Figure 5-5B]. People come to it because you have three tiers there. You know, you have the faces on there. The art is very different that you don't normally see. Details are very important, adding the little stones to it [the fountain], adding the faces. People walk by, right to the fountain and say, "Oh, it's beautiful." They want to touch it. Color and movement attracts them.

Marcus and Francis (1990) agreed, stating that art should incorporate steps or ledges so that people can get close to the art for a sensory experience. Figure 5-5C shows a sculpture,

which invited touching, in a small courtyard of the historic street in Healdsburg. A strong arts orientation can become an identifying theme that helps to humanize and add meaning to the environment. Even utilitarian components, such as fireplugs, manhole covers, and fencing, can become art (Paumier, Ditch, Dimond, & Rich, 1988). When asked if there was enough variety on 2nd Street one participant replied, “No, I think that’s what’s missing.” When prompted, he added, “Art pieces, public art in the middle. You want to go see what that is.”

### **Building Projections/Facade Patterns**

Building projections and facade patterns are proposed audit features based on the high number of codes that included them and the interview comments. The importance of pattern for creating walkable streets is also supported in the literature. Smith (2003) noted that architectural style is not what conveys the aesthetic message, but abstract features, such as the lines and edges (of windows, doors, lintels, balconies, and walls), which create patterns. Pattern from windows and other features is demonstrated by the building shown in Figure 5-5D on First Street in Livermore.

Complexity of the buildings adds to complexity of the street. Hypothesized, but non-validated features, such as building projections, awnings and overhangs, doors, and primary building materials, are significant features because they play a large role in creating pattern, which is a basic design element created by repetition of features. *The Pasadena Central District Specific Plan*, (City of Pasadena, 2004), District Wide Guidelines for Building Design, includes Guideline BD 3: Unify and Articulate Building Facades. The intent of the guideline is described as follows:

Ultimately, all buildings need to make a positive contribution...A set of responsive, regulating proportions will contribute to a coherent building design and promote architectural unity within the Downtown. Proper articulation of a building’s facade will add to the richness and variety of Downtown architecture. (p. 154)

When asked about variety on 2nd Street, one participant compared it to streets in Ventura and Los Gatos, California, saying, “There every building looks different. I think it’s one thing we don’t have here. The buildings almost all look kinda the same, a little too similar.”

Although pattern is not regulated as a specific feature in the codes, many of the codes note that pattern is an important urban design quality to achieve primarily through the regulation of other features. The codes typically use the term “pattern” in describing the intent of the design standards. Pattern is described as the concept of continuity and rhythm in the relationship of building components. For example, *The City of Pasadena Central District Specific Plan*, (City of Pasadena, 2004), Building Design Recommendation BD 3.3 stated:

Respond to the regulating lines and rhythms of adjacent buildings that also support a street-oriented environment, regulating lines and rhythms include vertical and horizontal patterns as expressed by cornice lines, belt lines, doors, and windows. (p. 154)

Some of the codes describe a pattern of building openings and distance between doors as being important. Recommendation BD 3.5 of the Pasadena code stated: “Provide a clear pattern of building openings” (p. 154).

Curran (1983) said that pattern, which he equates with complexity, is one of three basic variables that affect the quality of a public space. Although pattern might be considered the generator of the UDQ of complexity, repetition of features create the pattern, such as repetition of the lines of windows, doors, and building edges. The pattern these features create can be observed and counted, making pattern an appropriate audit item. When asked about complexity of the street, one interview participant stated, “The details of the buildings, the windows, they have added character. It’s not just flat front spaces. I like the awnings (Figure 5-6A), and they’re all unique little spaces. Kentucky Street has more grooves so you want to stroll it and see what’s around the corner.”

Much of the pattern and detail that create complexity are accomplished through building projections and materials, and 77% of the codes regulate building projections. Many of the codes (83%) regulate the depth of awnings and overhangs. Those that regulate awnings typically also regulate marquees and balconies, colonnades and arcades, and bay windows. Curran (1983) noted that awnings and arcades are important. They give the streets visual cohesion and complexity, and they extend indoor activities to support the commercial activity of the street. When asked what features encourage people to walk on 2<sup>nd</sup> Street, one participant said, “I think the awnings [Figure 5-6A] for one because it brings something physically off the building.”

Two of the interview participants recognized the importance of projections when they commented on the flat wall of the theater on 2<sup>nd</sup> Street. One participant said:

This whole side [of 2<sup>nd</sup> Street] you have the theater building and it's again, its flat-- no windows, no glass. They helped by putting up the movie posters [Figure 5-6B]. But when you're looking down, you don't see it, the metal frames, really, if some were protruding out maybe.

Another participant echoed that thought: “I think the movie theater has created that problem with that whole side because it's just a blank wall.” Smith (2003) wrote that the windows and walls of each building create a secondary pattern to the super-pattern of all the buildings on the block, and a blank wall disrupts the pattern. Hedman (1984) noted that complexity and richness of detail, repeated from building to building, influence the way that sunlight will create shadow patterns (Figure 5-6D). In his book, *Great Streets*, Jacobs (1993) described a medieval street, Via dei Giubbonari, in Rome, as having building facades richly detailed with a constant change of brightness and shadows as light passes over shutters and cornices, sills and frames, signs and lights, and downspouts. One participant talked about the light on Kentucky Street: “The colors and the light and everything is sort of warm and inviting, like it makes you feel at home and comfortable.” These concepts are supported in the codes with

many of the codes regulating facade details, such as cornices, pilasters, expression lines, and ornamental relief with the specific intent to cast shadows.

Other sources of pattern are the turns and angles of roof silhouettes. Stamps (2000) stated that the shape complexity of the building silhouette (Figure 5-7A) is critical to recognizing the building and that complexity can be determined objectively by assessing geometric properties (angles and turns) of the roofline shape. Hedman (1984) wrote that the number of turns and angles contribute to visual pattern and complexity, adding that the pattern of a repeated silhouette can also create visual unity. Section 9 of *The Pasadena Central District Specific Plan* (City of Pasadena, 2004) supported this notion with Guideline BD 8: Design Roof Silhouettes. The intent stated: “A building’s silhouette can provide a memorable image...The rooftop should be interesting and favorably add to Downtown’s skyline” (p. 159).

### **Paving Materials**

A variety of paving materials is often used to create a pattern in the sidewalk and streets for a cohesive effect. Paving materials is a proposed audit feature because paving materials and textured sidewalks are regulated in 30% of the codes, and there are numerous citations in the literature. Curran (1983) discussed the use of paving materials to organize, link, and subdivide spaces, particularly with pattern in the ground treatment. He stated that the rhythm and repetition in the pattern helps to discern distances and keep pedestrians in clearly marked areas. One participant recalled a street in Los Angeles when thinking of memorable streets: “They put pavers in the whole strip. I remember the pavers because it made it very much different.” He commented on the pavers on 2nd Street: “The pavers that go across, you don’t see it everywhere. People remember to cross at the pavers.”

## **Parking**

Parking is a proposed audit feature because parked cars are regulated in 83% of the FBCs through the requirement of parking bays. They are considered an important street feature because they provide a buffer between the pedestrian and moving traffic (Figure 5-7B). They also promote pedestrian use by providing short-term parking. Parked cars are regulated by code through the provision of on-street parking for vehicles. However, many of the codes also recommend parking structures in liner buildings to promote the “park once, pedestrian first” concept.

Not everyone agrees that on-street parking is important. When asked if walking was a pleasant experience on Kentucky Street, one participant replied, “We actually wish there were no parking, no cars at all on Kentucky Street. It would be a perfect street where parking could be at either end and would cause people to just walk up and down the street.” Paumier et al. (1988) stated that the way parking is handled is one of the most important issues for a quality place for people. They explained that parking frontage on key pedestrian streets must be strictly controlled and parking structures should be encouraged.

Several of the interview participants had an opinion on parking. One participant stated: “The public garage is great. Parking is important.” But she also lamented the railings and elevated sidewalks on 2<sup>nd</sup> Street: “The parking and sidewalks are horrible. They’re just horrible because anybody who parks has to walk in the street to get to the sidewalk. They can’t walk from their car to the sidewalk.” One participant talked about a study Petaluma had done on why people do not go to the historic downtown. The city noted that the number one complaint was no place to park--although all the streets have parallel parking and Kentucky Street has one side of diagonal parking. With further research, they found that people did not know how to parallel

park, so unless a diagonal space was available, in their mind, there was no parking. Another participant compared Kentucky Street and 2<sup>nd</sup> Street saying, “When you’re walking, you can’t see across the street [Kentucky] because of the [parked] cars. I mean you can’t visually see it. When you are walking in the new area [on elevated walks on 2<sup>nd</sup> Street], you can see horizons and vistas.”

## **Summary**

The features in the complexity model are strongly supported by the literature, the user comments, and their prevalence in the FBCs as significant features for a walkable urban street. Approximately 53 different features are regulated by the FBCs that collectively create the four audit features for complexity. Three of the non-validated features-- building projections, paving materials, and parking-- can be measured and recorded and are proposed to be added to the audit model. They are regulated in many codes and the users felt they were important for a walkable street. The complexity model is one of the stronger models in the audit, and many features related to complexity are regulated in the codes, which suggest that the FBCs have the potential to create a walkable urban street that is high in complexity.

## **Human Scale Model**

The UDQ of human scale was found to have the third highest descriptive power for a walkable urban street in the street survey. Ewing et al. (2005) described human scale as follows:

Human scale refers to a size, texture, and articulation of physical elements that match the size and proportions of humans and, equally important, corresponds to the speed at which humans walk. Building details, pavement texture, street trees and street furniture are all physical elements contributing to human scale. (p. 43, Appendix 2)

Orr (1985) stated that features, which are in proximity to the walker and have dimensions that relate to the human body, such as street trees, architectural detail, street furniture, and pavement texture, all contribute to human scale. Many of the codes include a reference to human

scale. For example, *The Pasadena Central District Specific Plan* (City of Pasadena, 2004), District Wide Guidelines for Building Design includes Guideline BD 7: Emphasize Human-Scale Design. The intent of the guideline is described as follows:

The individual interacts with the street level of a building in an intimate fashion, and this is likely to influence our perception of the entire place. If emphasis is placed on the human scale, buildings will communicate that Downtown is an inviting and pleasant living environment. Rich visual details at the street level add interest and character to the facade, setting the stage for an active street environment and reinforcing pedestrian comfort. (p. 158)

### **Audit Features for Human Scale in the FBCs**

The Phase I audit included the five features listed for the human scale model (Adapted from: *Measuring Urban Design Qualities Related to Walkability: An Illustrated Field Manual*, Measuring Urban Design Qualities Scoring Sheet, Clemente et al., n.d.). Although 35 features were originally hypothesized for human scale in the Ewing et al. study, only five were validated for the audit:

- Number of long sight lines (both sides, beyond study area)
- Proportion of windows at street level (your side, within study area)
- Average building heights (your side, within study area)
- Number of small planters (your side, within study area)
- Number of pieces of street furniture/items (your sides, within study area)

Close to half of the complexity features are regulated in the codes. On average, 40% (2.4 out of 6) of the validated features for human scale are regulated in each code. Building heights appear in 29 codes (96%) and first floor windows in 27 (90%) of the codes. The number and percent of codes that regulate each human scale feature are as follows:

- 29 (96%) Building heights
- 27 (90%) First floor windows
- 14 (47%) Street furniture
- 6 (20%) Small planters
- 5 (17%) Long sight lines

The human scale model in the audit scored in the middle of the models for both the historic and FBC streets. Although the historic streets had a higher average score in the audit, three out of the top five highest scores for human scale were on streets built from Form-Based codes, including Mountain View, Hercules, and Livermore. The codes for these communities all regulated three out of the five audit features, including building height, first floor windows, and street furniture. However, all five of the audit features, including small planters and long sight lines, were present and recorded in all three of the streets.

The feature of “long sight lines” is regulated in only five codes, possibly because it is difficult to regulate as a design feature since it is affected by many other features within the street corridor. Building height, street trees, and building projections can all affect long sight lines, which is defined by Ewing et al. (2005) as the ability to see about three city blocks into the distance at any point during the walk through the block. The FBC streets all had at least one long sight line (a negative feature for walkability), primarily because the streets are new and street trees on these streets are young small trees with little canopy (Figure 5-8A). The arching canopies of large street trees are the primary feature to affect long sight lines. The tree canopy is what provides the sense of enclosure and acts as a ceiling to provide the human scale, which is why long sight lines are also considered in the enclosure model. Although long sight lines are not directly regulated in the codes, they are indirectly regulated through other features, such as street trees, building setbacks, street width, sidewalk width, and heights of buildings. These features are all regulated in the Hercules and Livermore FBCs.

Small planters are another feature that was not regulated in the codes, but appeared numerous times on the streets. Small planters are regulated in 6 out of the 30 codes reviewed, yet they appeared in large numbers on all the FBC streets surveyed with the exception of Gilroy

(which had large in-ground permanent planters). Small planters are those that appear to be permanent. They are not in-ground, but they are also not small enough to be taken inside. Most of the small planters along the FBC and historic streets were of different styles, shapes, and sizes. Some appeared to have been placed in front of businesses by the owners. Some streets had high numbers of large, heavy planters because they were used to cordon off seating areas for outdoor cafes in the diagonal parking spaces and on the sidewalks (Figure 5-8C). The use of small planters is an example of a feature that might not be regulated but appears on the street through other means.

### **Regulated FBC Features Related to Human Scale**

Regulated features related to human scale are linked with an audit feature (in bold) to show how regulated features can indirectly or collectively create the human scale features on the street. For example, small planters are not regulated but they are often considered to be street furniture or public art.

- **Number of long sight lines** may be regulated in the code through: street trees (spacing and type), building heights, building setbacks, street width, sidewalk width, traffic lights, terminated vistas, landmarks, and signage.
- **Proportion of windows at street level** may be regulated in the codes through: storefront window shapes, display windows, window proportions and size, percent fenestration on the facade, window placement patterns, and style of architecture.
- **Average building heights** may be regulated in the codes through: architectural style (historic buildings), scale and mass to match existing buildings, building type, building proportions, building height to width ratio, and building height to street width ratio.
- **Number of small planters** may be regulated in the code through: street furniture, miscellaneous street items, and public art.
- **Number of pieces of street furniture** may be regulated in the code through: benches, pedestrian lights, trash receptacles, planters, bollards, banners, bike racks, chairs, tables, umbrellas, clocks, newspaper racks, shade structures, bus stop shelters, kiosks, parking meters, drinking fountain, signs, and mailboxes.

## Proposed Audit Features for Human Scale

The literature, code review, and observations of the interview participants support the existing audit features. Three features are proposed to be included as an audit feature in the human scale model. “Street trees” are proposed because many of the codes (73%) regulate common tree spacing and type, 67% regulate trees in wells or landscaped beds, and 57% regulate the number of trees. “Coordinated pieces of street furniture” is proposed as an additional audit feature to count those pieces of furniture that are coordinated or belong to a set separate from miscellaneous street furniture. This audit feature is proposed because many of the codes emphasized coordinated furniture for a cohesive look. Facade detail and decoration were proposed for imageability, but they were also included under human scale because the literature shows that buildings with detail are perceived to be less massive and more human scale. The proposed features are listed with a qualitative description for an audit.

- **Street Trees:** Regulated features such as trees in wells/landscaped beds, , common tree spacing and type, trees in planters, trees in landscaped median, and proportion of sidewalk shaded should be counted in the audit as “number of street trees.”
- **Coordinated Street Furniture:** Regulated features made with the same details and materials such as benches, pedestrian lights, trash receptacles, planters, bollards, bike racks, clocks, drinking fountain, signs, and mailboxes should be counted in the audit as “number of coordinated pieces of street furnishings.”
- **Façade Detail and Decoration:** Regulated features such as cornice/parapet with cornice cap, regularly spaced windows, pilasters, sign bands, storefront cornices, transom windows, awnings, display windows, bulkheads, light fixtures, trim, medallions, moldings, decorative panels, and architectural style should be counted in the audit as “number of buildings with façade detail and decoration.”

## Expert and User Perspectives

The literature, comments from the users, and frequency of regulation in the codes supports the value of human scale for a walkable urban street. Two audit features, “number of long sight

lines” and “proportion of windows at street level,” are also included in the enclosure and transparency models on the audit. They are discussed in detail in the review for those models.

### **Average Building Heights**

Hedman (1984) noted that the silhouette of the roof line helps to contain the space as long as the roofs are approximately the same height and united by a similar pitch (Figure 5-8B). He explained that two walls must contain the space, and a uniform height of street space gives the street cross-section strong unifying proportions. One interview participant commented on the height of the buildings on Kentucky Street: “The street is inviting in that there is nothing higher than two levels, and really, for the most part, there’s nothing higher than one level so you don’t feel dwarfed as a pedestrian. You know, it’s just sort of comfortable.”

### **Number of Small Planters**

Although small planters are regulated in few codes, they are considered to be important to human scale (Figure 5-8C). The development regulations of the *City of Brentwood Downtown Specific Plan* (City of Brentwood, 2005, retrieved April 12, 2006, from [http://www.ci.brentwood.ca.us/departments/cd/planning/downtown\\_specific\\_plan/downtown\\_specific.cfm](http://www.ci.brentwood.ca.us/departments/cd/planning/downtown_specific_plan/downtown_specific.cfm)) stated: “Public gathering spaces should be detailed with decorative, pedestrian-scaled site furnishings, including seating, free-standing planters, etc.” (p. 50). One interview participant talked about a plan to put more planters in the courtyard on 2nd Street: “They are going to put some planters inside here, and the planters will bring warmth, because of the green. We have some trees; we have trees that, again, add the warmth to it.”

### **Buildings with Facade Detail and Decoration**

This feature also appears in the imageability model, but applies to human scale as well. Street trees and street furniture are the two features most closely associated with human scale,

but building details at the street level are also important. Orr (1985) noted that architectural elements influence the scale of buildings and sense of space. Stamps (2000) stated that surface detailing had the largest effects on preference. Many of the codes regulate facade detail either through architectural style (highlighting the details typical of that style) or through a diagram of desirable details.

The building design guidelines in the *Pasadena Central District Specific Plan* (City of Pasadena, 2004) include details such as light fixtures, canopies, awnings, and display windows. They encourage separate storefronts, details that provide evidence of artistry and craft, and windows with multi-layered displays. Window displays were mentioned by several interviewees. When asked what, if anything makes people want to walk on Kentucky Street, one participant noted: “The window displays that the retailers are doing. There’s just a lot to take in.”

Unwin (2003) explained that building details should be used to interrupt the vertical thrust of buildings (with belt courses), and finish the height (with cornices) to infer a roof over the street and imply human scale. Another quality of facade features is that they can make a building seem less massive. Stamps (1998) found that facade articulation (projecting and receding parts) and partitioning were associated with less apparent mass because vertical breaks slow the movement of the eye upward. Figure 5-8D shows examples of partitioning on Monterey Street in Gilroy.

Curran (1983) said that one dimension of streets, the length, can be manipulated with the use of curvilinear patterns, bends, and building projections to produce enclosure. One participant noted that:

Adding depth to it [the building façade along the street] is really important, it gives it more character, and I don’t like straight lines. If you have a little, you know, curve or something, or if you add a little angle, whether it’s the road or the street instead of having it straight on, I think it looks better when they add some different cuts to it.

## Street Trees

Ford (2000) declared that “trees help turn spaces into places” (p. 120), and can give a street a unique identity even when the architecture is nondescript. *The Pasadena Central District Specific Plan* (City of Pasadena, 2004), District Wide Guidelines for the Street Environment includes Guideline SE 4: Plant and Maintain Street Trees. The intent of the guideline is described as follows:

Street trees provide numerous benefits and are an indispensable part of the Downtown environment. Most obviously, they enhance the visual quality of the area. Street trees also provide cooling effects and contribute to the spatial definition of the street to create a human-scaled space with a comfortable sense of enclosure. In general, street trees add a gracious quality to Downtown. (p. 140)

Paumier et al. (1988) noted that street trees are probably one of the best downtown urban design investments because they provide a unifying visual element. Burden (2006) said the green area where street trees are planted adds significantly to aesthetics and placemaking, creating a more pleasant walking environment and increasing walking. The *Downtown Gilroy Specific Plan* (City of Gilroy, 2005) stated: “The addition of street trees in many cases can be the single biggest improvement to a revitalizing community. It is the number one improvement priority for the Downtown.” (p. 104).

Rubenstein (1992) and Burden (2006) explained that trees have functional and economic benefits, including climate control and environmental engineering (air purification, noise, glare, and erosion control). Plus they have architectural and aesthetic uses, such as space definition, screening, continuity, and view control.

Arnold (1993) stated that tree rows connect ends of buildings, and tree patterns that reflect building form connect the building to the street, adding that trees are more important today because buildings lack complexity in their architecture. He also explained that trees vertically define a space with a ceiling of branches, and they horizontally enclose the area with their trunks.

One interview participant, when asked if Kentucky Street had a room-like quality, talked about trees: “The trees lining the street. It just has that sort of cozy [feel], like you want to stay longer on the street.”

A small number of the codes (17%) also regulate shade on the sidewalk, either by trees or overhangs (Figure 5-9A). When asked what makes people want to walk on Kentucky Street, one participant noted: “There’s a lot to take in. Its tree lined, there’s grates.” Another participant, when asked what makes the street a comfortable space, replied, “Landscaping, trees, how the trees are set into the area.”

Not all the interview participants agreed on the importance of street trees. One participant commented: “From a visitor’s point of view, it’s nice to have trees growing. From a vendor’s viewpoint, I hate the trees because it blocks the view. We’ve got windows up above [on the building] and it blocks them.” Another participant talked about the trees on Kentucky Street saying: “They could have done better trees for sure; even palm trees would have been cool. Something that bursts up above the buildings would have been awesome, and it would have totally canopied it.”

### **Coordinated Street Furnishings**

This feature is proposed in addition to one of the existing audit features, “number of pieces of street furniture.” Streetscape is important because it plays a major role in creating a sense of identity. Streetscape unifies an area and provides for the comfort and safety of users. One key to the use of streetscape, emphasized in many of the codes, is the unifying effect of coordinated street furnishings. If street furnishings are haphazard and mis-matched it is likely to have the opposite effect, that is, a chaotic look that tends to create a lack of unity and loss of sense of

identity. However, one participant, when asked about what made the street interesting, commented on the lack of uniformity as a possible desirable quality:

There's definitely a lack of uniformity, which we enjoy to a part, because we are all unique and all individual and all have different businesses. There are different things that streets like ours do that create more [uniformity] like the planter boxes that line the street are all the same.

Paumier et al. (1988) noted that repeated use of street furnishings creates a visual overlay that reinforces the organizing structure of the streets (Figure 5-9B). *The Pasadena Central District Specific Plan* (City of Pasadena, 2004), Public Realm Design Guidelines for Street Environment, Guideline SE 5 stated: Provide Ample Street Furniture. The intent included:

Walking downtown should be a pleasant and comfortable experience. Long walks without places to pause and rest may become daunting for some pedestrians. Street furniture, when combined with street trees and proper lighting, humanize and communicate the true nature of downtown streets. Most importantly, furnishings should include benches and trash receptacles. (p. 141)

The guidelines also include a recommendation (SE 5.1) for placement of furniture, noting that benches and trash receptacles should be placed at frequent intervals for pedestrian comfort and use. When asked if anything on the street encourages people to interact, one participant said he did not see a lot of interaction: "Even though I know they have benches out there, I don't see a lot of the people using the benches like I thought maybe they would. Out in front of our store they do because it's a food place." One interview participant commented on the location of benches, planters, and trash cans on Kentucky Street:

The city decided to add benches, so we have a bench in front of our window. Nobody had any say in the location. It was just bolted and then I'd rather not have one in front of my window, it blocks access. And the egg-shaped planters, [Figure 5-9C] it's very charming, but nobody had any say in it, and the plants must be maintained by the merchants. When they put in the garbage cans, they're nice little quaint trash cans; they didn't put one in on this side of the street. They finally put one on this side of the street, but it's more toward my business than the bar.

One participant, when asked what makes the street a comfortable space, replied: “Garbage accessibility, so that you don’t have to walk two blocks to throw something away...also benches.” Another participant replied, “I like the benches. You can go and relax and sit and people watch.”

Pedestrian street lights are an important functional and aesthetic street furnishing. *The Pasadena Central District Specific Plan* (City of Pasadena, 2004) noted that the size and scale of the lights are important. The smaller, human-scaled fixtures suggest the street is safe to walk and the sidewalks are the pedestrian’s realm. Sixty percent of the codes regulate pedestrian scale street lights (Figure 5-9D). One participant talked about pedestrian street lights, remembering a street in Los Angeles that he had visited:

I remember still to this day the lights going down because they’re big, huge lights and the sconces and everything were gorgeous, and I still remember thinking, walking down there, this is gorgeous. I still remember the lights, tick, tick, tick, all the way down. Those big lights make a difference.

When asked what features encourage people to walk, the same participant commented on the lighting on 2<sup>nd</sup> Street:

We have individual lights on the building and then we have the light posts. Sometimes when you get a crowd of people, the light posts seem like they’re in the way, but overall I think they did that here very well. It’s that old fashioned looking type of light.

## **Summary**

On average, the codes regulate only about half of the human scale audit features, but they also regulate many other features, such as type of windows, building proportions, and street furniture, which are related to human scale. When brought together on the street, these features create the audit features in the human scale model. Two features derived from the FBCs; “building facade details” and “coordinated street furniture”, plus one non-validated feature, “street trees”, are strongly supported in the literature and in the FBCs as noteworthy features for

human scale. These features are proposed to be added to the human scale model on the audit.

Many regulated features link to the audit features and result in the audit features for human scale being present on the street, which suggest that the FBCs have a high potential to create a walkable urban street based on the human scale model.

### **Enclosure Model**

The UDQ of enclosure was found to have the second lowest descriptive power for a walkable urban street in the survey, putting it just above transparency. Ewing et al. (2005) described enclosure as follows:

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. (Appendix 2, p. 42)

The literature has many descriptions of enclosure in the outdoor built environment. Alexander et al. (1977) stated that buildings on streets should form a continuous fabric with surrounding buildings, and the height and setback should not vary too much to create enclosure. Hedman (1984) noted that the height of the walls is crucial to the sense of enclosure and orientation. Trees have been seen as important to enclosure because they form a wall of green, allowing pedestrians to feel separated from vehicles (Burden, 2006). Many of the codes include a reference to enclosure. *The Pasadena Central District Specific Plan*, (City of Pasadena, 2004), Public Realm Design Guidelines for Street Environment lists Guidelines SE 3: Protect and Shade Pedestrians, and SE 4: Plant and Maintain Street Trees. The design criterion explained: “A street should read as a well defined space” (p. 139) and recommendations include:

Emphasize the planting of street trees to provide overhead cover, and buildings adjacent to sidewalks should provide overhead cover in the form of canopies, awnings, and overhangs....Plant street trees to define the street and sidewalk, emphasize the consistent use of tree species, size and spacing along a street to create a pleasant rhythm and reinforce the space of the street. (p. 140)

## **Audit Features for Enclosure in the FBCs**

The Phase I audit included the three features listed below (adapted from: *Measuring Urban Design Qualities Related to Walkability: An Illustrated Field Manual*, Measuring Urban Design Qualities Scoring Sheet, Clemente et al., n.d.). Although there are only three features, two are counted twice because the quality of enclosure is dependent on both sides of the street having a street wall, and the proportion of sky is important in all directions.

- Number of long sight lines (both sides, beyond study area)
- Proportion street wall (your side, within study area)
- Proportion street wall (opposite side, within study area)
- Proportion sky (ahead, beyond study area)
- Proportion sky (across, beyond study area)

The audit features are not highly regulated in the codes. On average, one out of three of the validated features is regulated in each code. However, one feature, percent of street wall, appeared in 24, or 80%, of the codes. The number and percent of codes that regulate each enclosure feature are as follows:

- 24 (80%) Percent of street wall
- 5 (17%) Long sight lines
- 2 (6%) Proportion of sky

The historic streets had a higher average score in the audit than the FBC streets. Four out of the five lowest scores for enclosure were on streets built from Form-Based codes. However, in the four highest scores for enclosure, three FBC streets, in Livermore, Gilroy, and Petaluma, scored the highest, along with the historic street in the town of Palo Alto.

The codes for Livermore, Gilroy, and Petaluma regulated only one feature (percent street wall) out of the three audit features. A review of the audits showed high scores for percent of street wall, typically 95% to 100%. The high scores may have been due to the fact that all of the codes indirectly regulate the street wall through various other features such as garden walls and

build-to lines. Many also had bulk provisions that include maximum and minimum building widths and side setbacks, and maximum and minimum lot widths. Circulation and open space provisions for pedestrians also affect the street wall, including courtyards, parks, plazas, alleyways, midblock passageways, and building entrances. Also the type of building, such as residential, (with porches, stoops, and raised foundations) and courtyard buildings or commercial buildings (with multiple store fronts) affect the percent of street wall.

### **Regulated FBC Features Related to Enclosure**

The features which are related to enclosure that are regulated in the FBCs are linked with the audit features to show how the regulated features can collectively create the audit feature on the built street. Number of long sight lines and percent of sky ahead share many features that influence both, but they are listed with the most relevant features for each.

- **Proportion of street wall** may be regulated in the code through: maximum and minimum building widths, side setbacks, build-to-lines, courtyards, parks, plazas, alleyways, mid-block passageways, building entrances, and type of building.
- **Number of long sight lines** may be regulated in the code through: street trees (spacing and type), building heights, building setbacks, street width, sidewalk width, traffic lights, terminated vistas, landmarks, and signage.
- **Percent of sky across/ahead** may be regulated in the codes through: arcades, colonnades, balconies, awnings, overhangs, shelters, street trees (spacing and type), building heights, building setbacks, street width, sidewalk width, traffic lights, terminated vistas, landmarks, and signage.

### **Proposed Features for Enclosure**

Four features are proposed to be included as audit features in the enclosure model: awnings and overhangs, safety features, street trees, and ratio of building height to street width. Awnings and overhangs are regulated in 83% of the codes, and arcades in 80%. Both awnings/overhangs and arcades were cited by 83% of the interview participants. Safety features are proposed because many interview participants cited several features that they related to safety. Street width

is proposed because it is a non-validated feature that is regulated in 67% of the codes. Although street width is a contributing factor for enclosure, the ratio of the width to building height is supported in the literature as being more important than street width alone. Therefore, the proposed feature includes both height and width. Street trees are also proposed for this model because in addition to human scale, street trees are important features for enclosure. The proposed audit features are listed with a description of the quantitative measure of the feature for the audit.

- **Awnings and Overheads:** Regulated features such as awnings, overhangs, and arcades should be counted in the audit as “number of awnings/overhangs/arcades.”
- **Safety Features:** Regulated features such as railings, street trees, landscaped buffers, width of sidewalk clear zone, curb extensions, large planters, pedestrian street lights, parallel and diagonal parking, paved surfaces, curb cuts, and car speed should be counted in the audit as “number of safety features.”
- **Street Trees:** Regulated features such as trees in wells/landscaped beds, common tree spacing and type, trees in planters, trees in landscaped median, and proportion sidewalk shaded should be counted in the audit as “number of street trees.”
- **Building to Street Ratio:** Regulated features such as street width, sidewalk width, median width, landscape buffer width, and building height should be counted in the audit as “ratio of building height to street width.”

### **Expert and User Perspectives**

The literature, the codes, and observations of the interview participants support the enclosure model as being important for a walkable street and they support consideration for additional features in the audit. Safety features were not hypothesized in the Ewing et al. (2005) study as features for walkable streets, but several features related to safety were on the list. The interview participants cited many features and related them to safety, such as railings, marked street crossings, speed of cars, parked cars, the width of the clear zone on the sidewalk, one-way streets, and the texture of the sidewalks and streets (as tripping hazards). Although this proposed

audit feature of safety features is a catch-all for many types of features related to safety, it was put in the enclosure model because most of the features are also related to enclosure.

### **Proportion of Street Wall**

Curran (1983) noted that the importance of the street wall is the expression of containment: the wall creates the form of the street that becomes the “container” within which the street functions. Moughtin (1992) explained that for the street to function as a place or an exterior room, it must be a completely enclosed unit. Unwin (2003) stated that the property of enclosure is affected by the room-like feel that is collectively created by the walls and openings in the buildings. But enclosure is also a perception that varies between individuals, based on their tolerance for an enclosed space. When asked if 2<sup>nd</sup> Street had a room-like quality, one participant commented:

I don't get the feel, there's no closure on the end. To me, it feels really open still, unlike San Francisco where you don't feel like its open to the sky because of the tall buildings. On 2<sup>nd</sup> Street, you have the lower sidewalk, then the upper sidewalk, then the building so it's almost like a coliseum. It's too open to be a room to me.

One participant commented on the street trees when asked about the room-like quality along Kentucky Street: “I agree, the canopy helps, but it's not dense, yeah, and you could stand out in the street or on the sidewalk and see someone for a pretty good distance.” However, another participant commented that Kentucky Street felt contained by the buildings, awnings, and trees.

### **Long Sight Lines and Percent of Sky Across/Ahead**

Long sight lines and proportion of sky are related features not directly regulated in the codes, but they are indirectly regulated by features that are in the codes. Both are created by the void between the buildings and are affected by elements, such as building heights, building setbacks, street width, sidewalk width, traffic lights, street trees (both spacing and type),

terminated vistas, and signage. Proportion of sky is also affected by the use of arcades, colonnades, balconies, awnings, overhangs, and shelters (Ashihara, 1970; Ewing et al., 2005; Jacobs, 1993; Hedman, 1984).

The property of enclosure is also affected by a sense of distinct boundaries, another individual perception that is affected by long sight lines. Although long sight lines are considered a negative feature for a walkable street (as opposed to distinct boundaries) some of the codes encourage view corridors as part of the community character. Preservation of view corridors is usually seen in codes for communities that have outstanding natural features that are scenic and regionally important, such as mountains and water views, or historic features such as towers or civic landmarks.

Petaluma has a historically important waterfront along the Petaluma River. The *Central Petaluma Specific Plan* (City of Petaluma, 2003, retrieved April 12, 2005, from <http://www.cityofpetaluma.net/cdd/cpsp.html> ) includes several references to the river, including Goal 6: Maintain Visual Landmarks. The goal stated:

Central Petaluma has a strong sense of identity that, to a great extent, derives from the presence of the river and the existing landmarks that recall the city's heritage and traditions....To the extent feasible, the visibility of these interesting elements should be maintained. (p. 42)

In addition, Goal 5: Orient Activities to the Petaluma River; also focuses on the waterfront: "Land use patterns should be oriented to the Petaluma River, focusing development toward the edge, providing for continuity of activities along it" (p. 30). When asked if 2<sup>nd</sup> Street felt like it had distinct boundaries, one participant replied:

Yes, I definitely feel boundaries. I don't know if it's the rock corners, but I know when I'm coming down the street, maybe because there is a dead end [sharp curve], I feel like that side of the street cuts me off.

Second Street turns 90 degrees when it comes to a historic building, the Petaluma Mill. The participant did say he was glad the city kept the mill because it is a very old historic building that was visually appealing.

### **Building Height to Street/Sidewalk Width**

The literature often links human scale and enclosure, noting that many elements, such as building height and street width ratio, relate to both (Figure 5-11A). Ashihara (1970) stated that a ratio of 1:1 height to width is the critical point for exterior spaces. Hedman (1984) agreed that anything over the 1:1 ratio limits the sky view. Alexander et al. (1977) stated that the width of the streets should not exceed the building heights. However, Curran (1983) postulated that the ideal height to width ratio can vary from one culture and era to another, and the actual scale of spaces relative to human beings is more important. One interview participant did comment on wall height: “If the walls are tall, they feel like they are closing in on you.”

Several of the codes include diagrams of the height to width ratios for different types of streets, depending on the type of building and uses on the street. For example, commercial streets typically have taller buildings relative to the street width than residential streets. Page II-4 of the *Regulating Code for the Central Hercules Plan*, (2001, retrieved April, 11, 2006, from <http://hercules-plan.org/>) diagrams the dimensions of a four-lane avenue with a 110 foot right-of-way (ROW) and minimum building heights of two stories and maximum heights of four stories. Page II-6 diagrams the dimensions of a main street with a 60 foot right-of-way (ROW) and minimum building heights of three stories and maximum of five stories.

When asked about Kentucky Street (a one-way street with diagonal parking), one participant felt the street had a room-like quality because of the width: “Absolutely, very high

walled. It definitely brings you in; it's narrow." Another participant felt Kentucky Street was a nice street to walk down because:

It's a nice tight street. It's got; it's thin, if you will. It gives the same air as you would find on Bourbon Street. It's nice. A lot of access to everything, you can reach out and go to so many different things.

Regarding sidewalk width, when asked what elements of the street and sidewalk design encouraged people to interact, a participant said:

I think the width has a lot to do with it." Another participant commented, "To me a nice wide sidewalk is much more inviting, and I always liked seeing that.... I've noticed when it gets a little crowded, people do this [twist their shoulders]. So if they have it wide enough, it makes it much more inviting to people to walk and stroll.

### **Awnings/Overhangs/Arcades**

Hedman (1984) noted that entrances are a zone of transition between two spaces. Curran (1983) explained that the treatment of the zone can express the inter-relationship of the two spaces, encouraging the use of entrance canopies and awnings to extend and overlap the two domains. When asked if Kentucky Street had a room like quality, one participant noted: "on Kentucky Street, they have huge overhangs that cover almost the whole sidewalk so if there's a torrential downpour, you can still hang out there." When asked what made Kentucky Street pedestrian friendly, a participant replied, "There are a lot of awnings on a lot of these buildings so on a pouring down rain day you don't really need an umbrella." When asked about physical comfort on the street, he replied, "Again, the awnings for sure, from sunlight, sun exposure."

Another participant had this to say about the awnings on 2<sup>nd</sup> Street (Figure 5-10B):

Nice awnings, except in the building that I'm in, there's like an overhang that goes around the whole building, and it originally almost looks like it's an awning, but it's not, because it has all these slots so that the rain comes pouring down and it's right in the door and so nobody really thought [that] through. Now, when they built the building across the street there's real awnings so when you walk in the door you at least have some sort of a break. But when you walk into my door it's all pouring down rain.

## Physical Safety Features

Safety features are a group of features that primarily protect the pedestrian from vehicular traffic, but also include general safety features such as pedestrian lights. These are sometimes addressed under provisions for comfort in the codes. Paumier et al. (1988) stated that the most important concept is to provide an adequate sense of separation and protection between vehicles and pedestrians. Burden (2006) noted that street trees create safer walking environments by forming visual walls and distinct edges to sidewalks that distinguish between pedestrian and vehicular environments. Most of the codes have provisions for features, such as wide sidewalks, landscape buffers with street trees, and parked cars, to help separate people and cars (Figure 5-10C). The *Pasadena Central District Specific Plan* (City of Pasadena, 2004), Public Realm Design Guidelines, Street Environment includes *Guideline SE 3: Protect and Shade Pedestrians*.

The intent of the guideline is described as follows:

The physical safety and comfort of pedestrians is critical to the success of Downtown. Pedestrians must feel they are in a safe situation, and that they are a welcome presence in the community. Streetscape design and amenities should emphasize pedestrian safety and comfort. For instance, the proper placement of street furniture introduces distances and a perceived protection from vehicular traffic. ...the overhead cover provided by street trees offers shade and reasonable protection from the sun and rain. (p. 139)

Recommendations in the code include a minimum five-foot clear pedestrian passage along public sidewalks, and also locating street amenities in a zone along or near the curb as a barrier to automobile traffic. Elements within the zone should include street lights, parking meters, street trees, trash receptacles, news racks, and heavy planters. Schmitz and Scully (2006) commented on the perception of safety and the importance of the quality and intensity of the lighting. They noted that lighting should be bright enough to ensure safety but not so bright to create glare.

With regard to comfort and safety of the user, two interview participants expressed frustration with the railings along a portion of 2<sup>nd</sup> street (Figure 5-10D). The railings are along elevated walkways to meet safety standards and one participant complained:

These ridiculous railings--the way they designed it and the elevations. They designed it in such a way that in some cases you have to walk half a block in the street in order to get to the sidewalk. So in my opinion, that's ridiculous and it doesn't make for very friendly walking.

Another participant noted:

One aspect of the street that people don't care for too much is the railing. It takes away from the old-fashioned feel. I don't like the look of the railing. Instead of noticing the sidewalks and the buildings, you see these galvanized metal look which is more sterile. You know, if it would have been wrought iron or something old fashioned, it would have been different.

One participant mentioned the problems with bicycles on the sidewalks on Kentucky Street: "I wish there was a way to enforce bicycles off of the sidewalk, even if it were just poles that they couldn't get through at the end of the sidewalk." Other features, such as obstructions in the pedestrian pathway and tripping hazards, are also addressed in most codes. One participant had a very strong opinion about the pavers on 2<sup>nd</sup> Street: "The cobblestones are real. They're dangerous and people trip on them all the time. It's just horrible."

Several features related to safety, which were hypothesized but are in less than 50% of the codes; include midblock crossings, speed tables, and pedestrian crossing lights. Other features that are often included in the codes, but were not one of the hypothesized features, include right-of-way (ROW) width, crosswalk width, pedestrian refuge islands, and minimal driveway cuts in the sidewalk.

## **Summary**

The difficulty with the enclosure model is that two of the audit features, "long sight lines" and "proportion of sky," are features that would not normally be written as a regulation in a

code. The other audit feature, proportion of street wall, was the one feature--out of the three-- that was regulated. However, several FBC streets scored very high on the enclosure model because the codes of those towns regulated a high total number of features that affect sight lines and proportion of sky. Three non-validated features; “awnings, overhangs, and arcades,” are proposed as audit features. They are strongly supported in the literature and by user comments as being noteworthy UDQ qualities for the enclosure model. Two additional proposed features are derived from the FBCs: “ratio of building height to street width,” and “safety features.” Safety features are proposed because a high number of interview participants cited several features related to safety. All of them mentioned, at least once, some safety concerns that they had while walking on the streets. General concerns included lighting at night (and activity at night), tripping hazards, and safe street crossings. The enclosure model has few audit features regulated in the codes. However, based on the number of regulated code features that create enclosure, enclosure may be considered an important model for a walkable street.

### **Transparency Model**

The UDQ model of transparency had the lowest score and therefore the least descriptive power in the street audit. Ewing et al. (2005) described transparency as follows:

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 (Appendix 2, p. 44).

Transparency is cited in the literature as a primary concern for streets for two reasons: (a) perceived (psychological) and real safety, and (b) the extension of public/private space.

Alexander et al. (1977) noted that details along the street should include windows and arcades to extend the territory between public and private. Schmitz and Scully (2006) explained that retail

merchants should be encouraged to include interesting displays in their storefront windows and be prohibited from covering the windows.

### **Audit Features for Transparency in the FBCs**

The Phase I audit included the three features listed below for the UDQ model of Transparency (adapted from: *Identifying and Measuring Urban Design Qualities Related to Walkability: An Illustrated Field manual*, Measuring Urban Design Qualities Scoring Sheet, Clemente et al., n.d.).

- Proportion windows at street level (your side, within study area)
- Proportion street wall (your side, within study area)
- Proportion of active uses (ahead, beyond study area)

In the audit of the streets, “Proportion of active uses” was determined by the obvious presence of an active business in the buildings and the type of business. Buildings which were empty (out of business) or were used for non-public, low foot traffic businesses were not counted as active uses. In the review of the codes, “proportion of active uses” was recorded as present in a code if the code included a list of permitted uses.

Two of the audit features for transparency are regulated in most of the codes with “windows at street level” in 90% and “street wall” in 80%. On average, 45% of the audit features (1.8 out of 4) are regulated in each code. The number and percent of codes that regulate each transparency feature are as follows:

- 27 (90%) Proportion windows at street level
- 24 (80%) Proportion street wall
- 5 (17%) Proportion of active uses

The transparency model scored the lowest of the five models on the audit of both the historic streets and the FBC streets. The FBC streets, however, had a higher average score on the audit, and three out of the top five highest scores for transparency; Hercules, Gilroy, and

Livermore, were on streets built from FBCs. The codes for all three communities regulated the proportion of windows at street level and the proportion of street wall. For example, the *City of Livermore Downtown Specific Plan* (City of Livermore, 2004) includes standards for windows in Chapter 6: Design Standards and Guidelines as follows:

1) Buildings shall include vertically proportioned facade openings; with windows that have a greater height than width (an appropriate vertical/horizontal ratio ranges from 1.5:1 to 2:1). Where glazed horizontal openings are used, they shall be divided with multiple groups of vertical windows, 2) Storefront windows shall encompass a minimum of sixty percent (60%) of the storefront facade surface area. Where greater privacy is desired for restaurants or professional services, windows should be divided into smaller panes, and 3) Windows on the upper floors shall be smaller in size than storefront windows on the first floor, and shall encompass a smaller proportion of facade surface area. (pp. 6-21)

### **Regulated FBC Features Related to Transparency**

The FBC regulated features related to transparency are linked with an audit feature to demonstrate how regulated features can indirectly create the audit features on the built street. For example the codes may not directly regulate “proportion of the wall that is window” but they might regulate features such as the shape of the window, the size of the window, and where the window is placed, which would all affect the proportion of the wall that is window.

- **Proportion windows at street level** may be regulated in the code through: storefront window shapes, display windows, window proportions and size, percent fenestration on the facade, and window placement patterns.
- **Proportion of street wall** may be regulated in the code through: maximum and minimum building widths, side setbacks, build-to-lines, courtyards, parks, plazas, alleyways, mid-block passageways, building entrances, and type of building.
- **Proportion of active uses** may be regulated in the code through: a list of permitted uses, recommended uses for street types, and building types.

### **Proposed Audit Features for Transparency**

Two features are proposed to be included as audit features in the transparency model. One is a non-validated feature: “visible sets of doors” that is regulated in a high number of codes

(77%). The other, a non-validated feature, “midblock passageways,” is proposed to be added because 33% of the users cited it in the interviews, and it is regulated in 40% of the codes. The proposed audit features are listed with a description of the quantitative measure of the feature for the audit.

- **Visible sets of doors:** Regulated features such as spacing of entryways, entryways per building, clear pattern of building openings, and frequent cadence of storefront entrances should be counted in the audit as “number of building entrances at street level.”
- **Midblock passageways:** Regulated features such as marked crosswalks, midblock passageways, pedestrian refuge islands, right-of-way width, crosswalk width, and curb extensions should be counted in the audit as “number of midblock passageways.”

### **Transparency Model Features- Expert and User Perspectives**

The literature and observations of the interview participants support transparency as an important quality for a walkable street. In addition, the features of building entrances and midblock passageways are supported as important features for a walkable street audit for the transparency model.

### **Windows at Street Level**

Windows at street level are regulated in 90% of the codes. Ewing et al. (2005) stated that the display window at street level, where transparency is most important, is the classic example of transparency (Figure 5-11A). Windows in shops, Curran (1983) noted, make the street level more visually complex by expanding into the street. When asked if windows were important, one participant replied:

I think [windows are important] because people are so visual. They want to see, oh, look at those pretty things. They want to see something that’s appealing to the eye rather than just a piece of wall [Figure 5-11A]. So I think it’s a huge part of it actually. People feel trapped walking along a blank wall. There’s one building at the Foundry Wharf. It’s creepy walking past it. It’s almost the whole block, and it’s a solid wall. There are no windows so we actually walk on the other side of the street.

One participant reflected this thought when she commented on the windows in her store: “The other thing is being able to see visually inside. I love my space, but there are windows that are opaque in my space, and any retailer knows you want your windows.”

Windows are so important to the character and function of the space that most codes dedicate an entire section to the design standards for windows. Chapter 4 of the *Downtown Gilroy Specific Plan* (City of Gilroy, 2005) and Chapter 6 of the *Livermore Downtown Specific Plan* (City of Livermore, 2004) include architectural design guidelines for windows. These guidelines include such stipulations as: windows at pedestrian scale and detail; color variation and detail in the framing; vertically proportioned windows with a greater height than width; windows covering a minimum of 60% to 80% of the storefront façade; clear glass only; upper floor windows relate to the window pattern on the ground floor; and storefront windows and doors of the same style.

### **Proportion of Street Wall**

The proportion of street wall feature is also included in the enclosure model. It was discussed in detail in the enclosure model review.

### **Proportion of Active Uses**

The proportion of active uses was not directly regulated in any of the codes; in other words, the code did not specifically say a certain percent of uses must be present on the street. But the codes do regulate uses through a list of approved or recommended uses for the zone and/or street where the code applies. A central concept of Form-Based codes is that the form of the built environment, rather than the use, is regulated. Katz (2004) explained that the form--the buildings and the configuration of the street--remains the same, but the use changes over time. While the use is regulated in the codes, it is secondary to the regulation of the built form.

Use is controlled typically through zones established on the regulating plan and the allowed land use/building types in each zone. Some codes, such as the Gilroy and Livermore codes, simply list the permitted or desired uses by street or district. Chapter 5: Districts, Land Use, and Development Standards, of the *Downtown Gilroy Specific Plan* (City of Gilroy, 2005) includes a “Permitted Use Table,” which lists desired uses for certain districts. These districts include the Downtown Historic District, Downtown Expansion District, Civic/Cultural Arts District, and the Gateway District. The *Livermore Downtown Specific Plan* (City of Livermore, 2004) also includes a table of permitted uses listed by streets in the downtown, including retail (grocery and specialty goods), eating, drinking, personal services, business services, and banks.

### **Building Entrances**

Curran (1983) said that the proportion of windows, bays, doorways, and other features provide the contrast between transparency and enclosure, with doors providing the functional linkage. The *Central District Specific Plan of Pasadena* (City of Pasadena, 2004) noted that visual transparency is a citywide design criterion, stating “a building should offer helpful cues about its access and use” (p. 156). The importance of building entrances is described in the *Private Realm Design Guidelines, Building Design; Guideline BD 5: Demarcate Building Entrances*. The intent of the guideline is described as follows:

Buildings should offer helpful cues to their access and use. A main lobby entrance to a building serves a different purpose than a storefront entrance to a street level shop. The difference in use should be accentuated in their design. Main entrances that are easily distinguishable provide comfort and ease for the pedestrian searching for their destination. Prominent entrances also add character, identity, and interest along the street. (p. 156)

The recommendations include providing well-marked, articulated, building entrances oriented to the street. These recommendations relate the size and scale of the entrance to the overall height and width of the building, using highly crafted materials or civic art pieces to accentuate the entrance.

The Pasadena guidelines also encourage a frequent and regular cadence of storefront entrances and display windows, separate storefronts and multiple entrances on long walls, and a greater attention to details at the street level. When asked about windows, one participant said:

I've heard comments from people that like to walk--that it's beautiful here. But on the other side of the street [2<sup>nd</sup> Street], it looks more like business industrial because it's not open with windows. It's, if you look across there, the building facade has a door, a couple windows, and then it's plaster. So it kinda loses it until you get down to the end where the restaurant is--then it's all windows. It has outdoor seating [Figure 5-11B]. It looks more inviting again.

Both the Gilroy and Livermore codes include extensive design guidelines for doors and entryways such as: recessed doors, archways or cased openings marked with a tower above; overhanging roofs and awnings; ornamental light fixtures; and accenting with architectural elements such as columns. The codes also include the use of special materials such as paving and decorative hardware; a change in roofline or wall articulation; windows in doors to permit views in; and high quality materials and detailing.

Conversely, most codes discourage the use of blank walls that are uninviting and which emphasize the mass of the building. Smith (2003) stated the overall sense of proportion of a building is determined by the relationship between windows and walls. If blank walls are unavoidable, codes recommend the use of murals, trellis, vines, or marquis display cases, especially in areas where a midblock passageway occurs between buildings.

### **Midblock Crossings/Midblock Passageways**

Midblock crossings and related pedestrian features are important for connectivity. When asked what encourages people to interact, one interview participant said the midblock passage from the parking garage to the street (Figure 5-11C) encouraged people to conveniently meet. She stated that "people always remember those walkways, once they discover them." Although midblock crossings are regulated in only 13% of the codes, curb extensions are a related feature

that is regulated in 53% of the codes. Schmitz and Scully (2006) recommended speed tables to delineate midblock crossings. They stated that midblock crossings may reduce the temptation to jaywalk. Some of the interview participants, however, liked the fact that Kentucky Street was narrow and one-way so pedestrians could cross anywhere. When asked what makes the street comfortable, one participant said, “You can cross the street easily jaywalking.” Another participant mentioned the tightness and width of the street, saying, “I’m not afraid of getting run over here.” One participant complained about the railings along the sidewalk on 2<sup>nd</sup> Street blocking the crossing:

Say, you’re walking across the street on this side and your friends are walking across the street on that side and you say, “Hey, John, hold on a second, let me go around [the railing].” Yeah, that old feel [without the railing] was you had that easy crossover.

## **Summary**

Transparency had the highest average number of audit features regulated in each code, and two features, percent of first floor windows and street wall are regulated in 80% or more of the FBCs. Many of the codes also put great emphasis on specifying the construction material and details for windows, pointing to the importance of windows at the pedestrian level. Although the features are regulated in many codes, and 50% of the interview participants cited first floor windows, the model still had the lowest scores in the audit. Two features derived from the FBCs: building entrances and midblock passageways are strongly supported in the literature and in the FBCs as noteworthy UDQ qualities for transparency. They are proposed to be added as audit features in the transparency model.

## **Model Summary**

The goal of this research was to explore the potential of Form-Based codes to create walkable urban streets. The results of this study show that they do have the potential to produce a pedestrian-oriented urban street based on several factors. Perhaps most importantly, the FBCs

regulate a high number of urban design details that create, through various combinations, the validated and non-validated urban design features and qualities presumed to be important for walkable urban streets. The FBCs also appear to regulate a high number of features that are preferred by the everyday users of the street. A key concept is that the codes regulate number of design details for a specified length of street. This is most important for the urban design qualities of imageability and complexity. These qualities rely on high numbers of features to create the synergy needed for a visually complex, interesting, and memorable street.

The FBCs which regulated the highest number of features scored the highest on the audit, but the optimal number or minimum number of features is not known. The high audit score suggests that the more features of the built street environment regulated in the codes, the more walkable the resulting street environment. The review of the models has shown that all the models and features are relevant for creating a walkable street. However, the imageability, complexity and human scale models are the three most powerful UDQ models for describing a walkable street. A greater number of features from these models may be more critical to ensure the desired combinations of features.

Several non-validated features were not included in the walkable street audit, but they are regulated in high numbers in the codes and mentioned frequently by the interview participants. Regulation in the codes suggests they may be important and should be considered for a walkable street audit. The discussion lead to the development of several criteria, listed in the conclusions and recommendations, which may have a bearing on the potential of the codes to create a walkable urban street.



A



B



C



D

Figure 5-1. Imageability features. A) Historic buildings, Kentucky Street, Petaluma. B) New buildings, 2<sup>nd</sup> Street, Petaluma. C) Courtyard, Kentucky Street, Petaluma. D) Fountain, 2<sup>nd</sup> Street, Petaluma.



A



B



C



D

Figure 5-2. Imageability: sidewalk features. A) Distinctive signage, 2<sup>nd</sup> Street, Petaluma. B) Landscape features 2<sup>nd</sup> Street, Petaluma. C) Landmarks, Railroad Avenue, Hercules. D) Outdoor dining, Castro Street, Mountain View.



A



B



C

Figure 5-3. Imageability: building detail. A) Facade detail, South Santa Cruz Avenue, Los Gatos. B) Quality construction materials, corner of C Street and 2<sup>nd</sup> Street, Petaluma. C) Facade details, Monterey Street, Gilroy.



A



B



C



D

Figure 5-4. Complexity features. A) Building width, Railroad Avenue, Hercules. B) Outdoor dining, Railroad Avenue, Hercules. C) Number of Buildings, Railroad Avenue, Hercules. D) Building Colors, 2<sup>nd</sup> Street, Petaluma.



A



B



C



D

Figure 5-5. Complexity: sidewalk features. A) Outdoor dining, 2<sup>nd</sup> Street, Petaluma. B) Public art, 2<sup>nd</sup> Street, Petaluma. C) Public art, Healdsburg Avenue, Healdsburg. D) Facade patterns, First Street, Livermore.



A



B



C



D

Figure 5-6. Complexity: building features. A) Awnings, Kentucky Street, Petaluma. B) Theater wall, 2<sup>nd</sup> Street, Petaluma. C) Awnings, 2<sup>nd</sup> Street, Petaluma. D) Shade patterns, University Avenue, Palo Alto.



A



B

Figure 5-7. Complexity: street features. A) Roof silhouettes, First Street, Livermore. B) Parked cars, First Street, Livermore.



A



B



C



D

Figure 5-8. Human Scale features. A) Long sight lines, Railroad Avenue, Hercules. B) Average building heights, 2<sup>nd</sup> Street, Petaluma. C) Small planters, Castro Street, Mountain View. D) Facade detail, Monterey Street, Gilroy.



A



B



C



D

Figure 5-9. Human Scale: sidewalk features. A) Street trees, First Street, Livermore. B) Coordinated street furnishings, Monterey Street, Gilroy. C) Street furnishings, Kentucky Street, Petaluma. D) Pedestrian lights, First Street, Petaluma.



A



B



C



D

Figure 5-10. Enclosure features. A) Building height to street width, view from Pacific Street, Santa Cruz. B) Awnings, 2<sup>nd</sup> Street, Petaluma. C) Physical safety features, Monterey Street, Gilroy. D) Physical safety features, 2<sup>nd</sup> Street, Petaluma.



A



B



C

Figure 5-11. Transparency features. A) Windows at street level, Kentucky Street, Petaluma. B) Building entrances, 2<sup>nd</sup> Street, Petaluma. C) Midblock passageways, Kentucky Street, Petaluma.

## CHAPTER 6 CONCLUSIONS AND RECOMMENDATIONS

The conclusions highlight a number of considerations that impact the potential of Form-Based codes to create a pedestrian-oriented street. To write codes that focus on walkability, it is necessary to put the following procedures in place. First, start with a good understanding of the design qualities and features that relate to walkability and are relevant to the user. Second, employ a methodology that allows for quantitative measuring of the features. Third, identify an effective format for design codes that will translate to a desired built form to meet the goal of walkability.

The results section of my study focused on a comparative scale of the quantitative design qualities and features suggested as important by a peer-reviewed published street audit (Ewing et al. 2005). The discussion section focused on the relationship of the regulated features in the Form-Based codes to the features in the street audit and the users' perceptions of the resulting streets. These conclusions and recommendations are drawn from the results and discussion.

### **Study Strategy**

The central conclusion of my study is that the FBCs have the potential to create walkable streets when they regulate a sufficient number of features related to walkability. The Phase I question asked if streets created from the application of FBCs possess the same UDQs and features as walkable historic streets. Results showed: (a) FBC streets have similar UDQs and features as historic walkable streets; (b) the UDQs of imageability, complexity, and human scale are the most important for creating a walkable street; and (c) regulating the frequency of features within a defined area is an important criterion for creating a code that produces a walkable street. Phase II was concerned with user preference. The interview questions were designed to learn the most important UDQs for a walkable street from daily users. The results of Phase II showed: (a)

The FBC streets are similar-- from the user's perspective-- to historic walkable streets; and (b) the UDQs of imageability, complexity and human scale are also the most important from the user's perspective.

Phase III examined the role of the codes, and asked if UDQ model features surveyed on the FBC streets were present due to application of the codes. The results showed the codes regulated few of the audit features. However, analysis of the codes revealed that combinations of many features regulated in the codes resulted in the audit features being present on the street.

The results generated six conclusions: (a) The codes should regulate a high number of features that link to the UDQs, particularly the imageability, complexity, and human scale models; (b) the codes must regulate the frequency that the feature appears in a set length of street; (c) the codes should regulate a high total number of features so there is a greater possibility that combinations of some features will produce the desired qualities; (d) advantages and disadvantages occur using the Ewing et al.(2005) UDQ models as a generator of features to be regulated in the codes; (e) a variety of styles of codes may meet the goal of creating a walkable street; and (f) more performance evaluation, focused on optimal numbers and frequency of features is needed.

The conclusions revealed several obvious questions that require, for the moment, speculative answers, including: (a) What is the optimal number of features a code should regulate?; (b) What is the optimal combination of features for each UDQ model?; and (c) What is the optimal frequency of features in a defined area? Other questions for consideration include: (a) the ability to use UDQ models developed from high-density urban streets on other types of streets, such as low-density residential streets, and (b) to what degree do cultural differences influence the effectiveness of UDQ models for generating codes.

## Using Urban Design Quality Models for Code Development

The UDQ models appear to provide a solid foundation for writing codes provided they include both the validated and non-validated features that were hypothesized for the UDQ models from the Ewing et al. (2005) study. The study originally proposed eight models that included legibility, coherence, and linkage plus the five models on the audit. The expert panel members in the Ewing et al. study relied on their professional experience, a review of the urban design literature, and a review of the visual assessment literature to design the UDQ models from the list of hypothesized features. The three models of legibility, coherence, and linkage were not included in the final audit. The loss of these models meant that several features, such as street trees and building materials were not on the audit. The features, however, appear frequently in the literature, the codes, and users' comments. This suggests they are important features that should be included in the codes and they were proposed as potential audit features in the discussion chapter.

The hypothesized list of validated and non-validated features for all eight models appears more useful for code development than the validated features from the five audit models because the hypothesized list provides a greater number of features relevant to the UDQs. One possible disadvantage of using predefined urban design qualities and features is that location-specific issues may not be addressed under any of the qualities and related features. Variability in communities may make standardization difficult, and location-specific issues should not be compromised. The UDQs can provide a good reference that will serve as a starting point. The community charrette, which is required for FBC development, is intended to help resolve location-specific issues.

Another possible problem with using a predefined list of features is that the focus on the individual features may obscure the need to consider the entire context of the street. Designers

must understand how the features relate to each other and the desired urban design quality. My study assessed the value of the UDQ models for developing design codes for walkability, but it is difficult to compare and assess the relative value (importance) of each feature in the models. Key features and key feature combinations were not determined by the Ewing et al. study or any other research investigated for my study. Certain features that are included in several UDQ models might be considered more important simply because they impact more urban design qualities. Checklist and rating systems can often be controversial for what they include and do not include, but attempts to refine them offer more opportunities for research and practical application.

### **User Perceptions and Urban Design Qualities**

Research has shown common architectural preferences among the public based on the emotional response of people to the visual quality of their environment. This aesthetic response is described as a favorable emotion based on feelings of pleasantness or excitement (Ataov, 1998; Nasar, 1994, 1997; Ulrich, 1983). When interviewing the users of the streets in Petaluma, it was evident their feelings and emotions were a key determinant in their assessment of the visual quality of the streets. Participants had a more favorable response to the details that affected the complexity of the street, such as building facade details, architectural style, building colors, signage, and street trees. They had a less favorable response towards the functional issues such as parking, pavement texture (a tripping hazard), and traffic speed.

The participants were also more sensitive to the features of the street perceived to directly impact their businesses, such as the location of benches (Figure 6-1A) that blocked windows, trash can availability, accessibility to their shop, and the location of trees in relation to their signs. Given the commonality of their preferences and the participants' ability to identify and describe their preferences, their participation was very valuable to determine features and design

qualities for code development. It is important, however, to consider other groups of users. My study included only business owner interviewees, who may have different preferences from the general user. Some participants commented they no longer noticed several features because of familiarity, while other features continued to be prominent. The variables of familiarity and change in significance over time may also have implications for the codes. Features that retain or grow in significance may be more important to include in the codes, particularly since one goal of the codes is to produce a built environment that will endure even as the uses change.

### **Strengths and Weaknesses of Urban Design Quality Models**

Using UDQ models as a basis for development of a street audit or design codes presents some challenges. The strength or weakness of the UDQ models depends primarily on the ability to identify and count the features in the model on the street, and the ability to describe, illustrate and quantify the feature in written codes.

### **Imageability, Complexity, and Human Scale Models**

Based on the audit scores, the features of the imageability, complexity, and human scale models were the most important for creating a walkable street; transparency and enclosure models were less important. The audit features of the imageability, complexity, and human scale models; particularly courtyards, signs, landscape features, building colors, art pieces, outdoor dining, windows, and street furniture, are notable because they are easier to identify, quantify, describe, and illustrate. These qualities may make them more relevant to Form-Based codes, since the codes regulate through description and measurement, and more relevant to an audit, which requires identification and numerical count on the street.

Because the FBCs use graphics and images to convey regulated features, it is more likely these features, which are easily depicted, can be regulated with greater ease. For example, the features related to building facades are easy to identify and count on the street and regulate in the

codes. The features also appear obvious and identifiable to the users because all the interview participants cited the historic buildings, the building colors, and architectural style (Figure 6-1B) as being important to encourage walking.

The vision statements of many codes reflect the desire to have a complex, interesting street environment. The *City of Livermore Downtown Specific Plan* (City of Livermore, 2004) includes a narrative of their vision, which conveys a sense of complexity and imageability:

Broad shady sidewalks, lined by ground-floor shops and restaurants, offering pleasant distractions each step of the way....Merchant display carts, outdoor diners, and parked cars share the street with pedestrians and cars and create a lively scene....New shade trees, large-scale planters, and pedestrian-scale street furniture shape an appealing walking experience. Art is a visible presence. (p. 1-1)

The literature and comments from the users reinforce the notion that imageability, complexity, and human scale are important. The concept that imageability is an important quality is supported by the definition for imageability from Ewing et al. (2005), they wrote that imageability is the most important quality to street design and is reflected in the composite effect of all the other qualities. Imageability is the quality that makes a place memorable, and it is influenced by variety and complexity in the environment. Complexity, in turn, refers to visual richness and also depends on variety in the buildings and landscape. Features that contribute to imageability and complexity, such as ornamentation, material, color, landscape and furniture, also affect user preferences. When used in a coherent, unified way, they are associated with feelings of pleasantness, an important indicator of preference (Cullen, 1961; Ewing et al., 2005; Groat, 1989; Hedman, 1984; Smith, 2003; Stamps, 2000).

When interview participants were asked what makes a street memorable, their comments included preferences for building facades, such as colors, details, and windows. In response to the question about what encourages people to walk, one participant said: “The older buildings, the structures are appealing because they are unique, so it has character to it. People like that old

feel.” Another, when asked if complexity encourages walking, commented: “Details are very important. Color and movement attracts them.”

Any feature that is associated with more than one model is important because it will affect several UDQs on the street. For example, one feature that imageability and complexity share is outdoor dining. Although few codes regulated outdoor dining, every street surveyed had at least a few tables and chairs for dining. On some streets, tables and chairs were very prominent (Figure 6-1C). One interview participant placed a set of tables and chairs in front of his business every morning and commented that people used them constantly.

The presence and number of courtyards, plazas, parks, landscape features, and public art pieces are also imageability and complexity features, which are straightforward and easy to regulate in the codes. These features (Figure 6-1D) are particularly important because they occupy the spaces between the buildings, and they provide for an essential concept of imageability, which is the visual and physical connection from space to space, building to building, and building to street. Plus they give meaning to the space because they are associated with values and ideas important to the community (Cullen, 1961). Nearly half of the interview participants cited courtyards and parks as important to walkability, noting that features such as fountains and art were an important element in the courtyards.

In addition to type of features, frequency for a defined distance or length of street (which affects numerical count) is an important criterion for a walkable street that is linked to imageability, complexity, and human scale. In addition, it is a standard that is easy to control in the codes and count on the street. As an urban design quality, complexity is not only dependent on the number and variety of features, but also the number of noticeable differences that the user experiences over time, which relates to frequency. Time is related to distance walked and a high

number of differences within a time frame will hold the interest of the user and is more desirable for a walkable street (Ewing et al., 2005; Rapoport, 1990).

The assertion that imageability, complexity, and human scale are the most important qualities has implications for the types of features that are regulated in the codes. The relative importance of the models to walkability also helps to determine the relevance of the models to the codes, as expressed in the conclusion; the codes should regulate a high number of features that link to the UDQs, particularly the imageability, complexity, and human scale models.

### **Enclosure and Transparency Models**

The features of UDQ models of enclosure and transparency were found to be the least descriptive of a walkable street. In contrast to the imageability, complexity, and human scale features, it is more difficult to describe and quantify sight lines, street wall, visible sky, and active uses, making it more complicated to incorporate in the codes and difficult to recognize and record in the street audit. Some aspects of the features in the models might explain why they were lower in the stratification of the audit models and how this might impact regulation in the codes. The primary issue with the features in these models is the ability to accurately quantify and describe features that are not physical objects in themselves, but are created by other physical objects. Attempting to regulate features that are not physical objects is related to three important concepts for quantitative measurements of design features; (a) the ability to describe and quantify the design feature, (b) the ability to link it to a design quality, and (3) the ability to specify a method to measure the frequency of occurrence of that feature in a defined area (Ewing et al., 2005; Giles-Corti et al., 2003; Smith, 2003; Southworth, 2005; Stamps, 2000; Zacharias, 2001).

Examples from the transparency and enclosure models of features that are less well defined include sight lines and proportion of sky, the proportion of street wall, and the proportion of active uses. Although the Ewing et al. study (2005) showed high inter-rater reliability for these features and the audit field manual gives explicit, detailed instructions for identifying features and estimating proportions, a greater possibility continues to exist for individual judgments. Some of the features are more difficult to directly regulate in the codes. For instance, it is not easy to specify in the codes the proportion of sky or number of long sight lines on a street. The codes can, however, regulate features, such as building height, awnings, street width, sidewalk width, street trees, and other vertical elements, that define and enclose the street and affect proportion of sky and sight lines (Ashihara, 1970; Ewing et al., 2005; Hedman, 1984; Jacobs, 1993).

Codes can also regulate enclosure and transparency features through narratives that provide statements of intent or descriptions of the desired experience. Some narratives simply state the reason for the regulation, or they can include a detailed description of how features should be arranged or combined. For example, some of the codes encourage view corridors, which affect long sight lines and proportion of sky, when they have outstanding natural features or historic features significant to the identity of the area (Figure 6-2B). An example of a statement of intents is in the *Pasadena Central District Specific Plan* (City of Pasadena, 2004), the Public Realm Design Guidelines for Community Character lists Guideline CC 4: Protect View Corridors. The rationale for the regulation is described as follows:

Downtown offers a number of high-quality views and vistas, in particular, prominent views of the San Gabriel Mountains and City Hall. These views distinguish Pasadena from other cities in the region, and orient residents and visitors alike to their location in the city. A strong Downtown identity depends upon the preservation and enhancement of these special views and view corridors. (p. 132)

Recommendations in the Pasadena code include framing important views through heights and location of buildings and looking for opportunities to open new views of landmarks, buildings, and features.

An example of a description of a desired experience includes one from the City of Livermore to regulate proportion of street wall. While many of the codes regulate the street wall through the use of standard build-to-lines, setback restrictions, building widths, and facade treatments, the Livermore codes also explain how to combine features to address continuity of the street wall. *The City of Livermore Downtown Specific Plan, Design Standards and Guidelines* (City of Livermore, 2004) regulates the horizontal mass of buildings (Figure 6-2A), along the street by describing the treatment of the street wall:

**Building Wall:** While the majority of the building is required to be built to the property line, portions of the building may recede from the public right-of-way. The building wall may be varied along the front setback line at key locations, i.e. recessing the storefront entrance, or creating a niche for a residential entrance. From one façade to the next, combine a change in depth or horizontal plane with a change in material and character. Changes in facade material or color should be associated with a change in plane or separated by a pilaster. (p. 6-9)

Some features are more easily regulated through both a narrative that explains the purpose of the regulation and extensive descriptions of details. One feature; “proportion of windows at street level”, is shared by the transparency and human scale models, but is most critical for transparency. Windows at the street level are regulated in 90% of the codes, and many have extensive descriptions of windows as features. These descriptions cite transparency as critical at the street level because windows extend the indoors, link the public and private spaces, give a sense of security, and provide visual interest (Curran, 1983; Ewing et al., 2005; Jacobs, 1993). A narrative that describes the importance of windows is included in the *Pasadena Central District Specific Plan* (City of Pasadena, 2004), Private Realm Design Guidelines; Building Design Guideline BD 4: Activate the Street Edge. The intent of the guideline is described as follows:

Accommodating public use at the ground floor is critical to a socially and visually stimulating Downtown, and street level facades offer the greatest opportunity to support pedestrian activity. Multiple storefronts, shop entrances, and activities enliven the street, sustain attention, and provide a safe pedestrian environment. Generous windows placed at the ground floor give people inside knowledge of those on the street, and the people on the street gain an awareness of the activity inside. This phenomenon is commonly referred to as “eyes on the street,” and supports an active day and night street environment. (p. 155)

Recommendations include promoting transparency by making the uses readily discernable to the passerby through the use of transparent glass (Figure 6-2C). Many participants commented on windows. One interviewee mentioned window displays: “We’ve got the bookstore, and their windows are always doing some sort of feature on artwork from one of the schools and that definitely creates that kind of spirit where people are walking by, they stop, they look at the window.”

The enclosure and transparency models in particular demonstrate how an assortment or combination of details or features must be regulated in a code to result in the desired design quality or feature on the street. These models also show how narratives or descriptions of intent can help to clarify the role of some of the features in producing the desired quality. Descriptive narratives can include one or all of the following: the desired user experience, the rationale or intent for the regulation, a description of how the features relate to and create the urban design quality, and recommendations for implementing the features. Linking a feature to the intent, the urban design quality, and the user experience makes it easier for the person using the code to understand the relationship of the feature to the design quality, the context, and the user.

### **Strengths and Weaknesses of Form-Based Codes**

The conclusions highlight a number of possible strengths and weaknesses in the format and content of the codes. The number, types, and combinations of regulated features are important, which is reflected in the format and style in which the code is written. All of these issues may have implications for the flexibility and transferability of the code format to a variety of street

conditions and different types of development. The types of features regulated and the described intent would probably have a greater impact on the consideration of cultural differences in the codes.

### **Regulated Features**

The results showed that codes that regulate a high number of features in each model and a high total number of features had a higher score on the street audit. These codes are also more likely to create the combinations that produce the desired UDQs, particularly in the key qualities of imageability, complexity, and human scale. The discussion of the results demonstrated that many combinations of features are regulated in the codes that produced the audit features. This plus the fact that the codes with the highest number of regulated features had the highest audit scores lead to the conclusion that the codes should regulate a high total number of features for a given street length. Several unknowns are relevant to these conclusions; some can be estimated from the data that were gathered in the street audits, and others can be estimated from the discussion comparisons.

Very few codes made a specific statement describing a particular key feature or the ideal combination and number of key features, or the desired frequency of features in a set distance. The *Downtown Gilroy Specific Plan* (City of Gilroy, 2005) noted on key feature: “The addition of street trees alone in many cases can be the single biggest improvement to revitalizing a community; it is the number one improvement priority for the Downtown” (p. 104). The literature describes trees as one of the best downtown urban design investments and suggests that the addition of street trees is most likely the most cost-effective feature for the biggest impact for a street (Burden, 2006; Paumier et al. 1988).

The ideal number of features, combination of features, and optimum frequency of features are unknown. Again, the *Downtown Gilroy Specific Plan* (City of Gilroy, 2005), did specify a minimum number of benches, planters, trees, and chairs for every 200 square feet along the street; however, most codes do not specify a combination of type, number and distance. Although the ideal combinations of features are not noted in the codes, some features emerged as “super-features” in my study based on the frequency that they were regulated in the codes and cited by the interview participants. These super-features might be considered to be the minimal combination of features needed for one block (200-300 feet) of a walkable street (one side). Many of the features are associated with the building façade. The number in parenthesis for some of the features is the estimated optimal frequency based on the average frequency recorded in the street audits. The features include: windows, architectural detail, awnings, building materials, roof silhouette, entrances (10 doors), signs (10 signs), colors (6 basic colors), and building widths (30-45 feet). Features associated with the sidewalk zone include: courtyards and plazas (2), planters (7), street trees (10), street furniture (20 pieces, including 4 benches, 6 trash cans, and 10 pedestrian lights), outdoor dining (15 tables), public art (2 to 3 pieces), and parked cars.

### **Flexibility of Form-Based Codes**

Other questions, which require some speculation, relate to the use of FBCs in a variety of different conditions or street types. The flexibility of the codes depends primarily on the style of the code, which may affect the ability to transfer the UDQ models and FBC format to other types of streets, such as residential streets. Cultural differences in the evaluation of walkable streets may also affect the ability to use UDQ models when writing codes.

The codes used for my study were written in many different styles. However the format of the codes, which maintains the core function of the codes, remained the same for each code

reviewed. All the codes included a regulating plan, building form standards, and architectural and public space/street standards; some of the codes included landscape standards. The difference in the codes is the style in which the standards are written. Some are very prescriptive and others rely on more general descriptions. A comparative example is the *Central Petaluma Specific Plan* (City of Petaluma, 2003) and the *Downtown Specific Plan for the City of Livermore* (City of Livermore, 2004). Streets from both cities were audited and they had the same stratification of UDQs, but the scores on the audit varied somewhat. The FBC street in Livermore had the highest scores in most of the models, and the street in Petaluma had scores in the middle of the range. The styles of the codes, however, are strikingly different, and it is tempting to attribute the difference in the scores to the difference in the code style-- but this would only be speculation.

For example, the *Livermore Downtown Specific Plan* (City of Livermore, 2004) uses detailed descriptions, with each chapter including a narrative for different types of buildings. Chapter 6, Design Standards and Guidelines for Commercial and Mixed-Use Buildings, described the architectural style for commercial and mixed- use buildings as follows:

New structures should be identifiable as “Livermore,” based on its most integral design styles and continuing its best traditions. They should be based on the same fundamental composition of the existing buildings in Livermore’s historic commercial Core, with a storefront base separated from the upper stories of the building, and incorporate characteristics commonly found in Downtown, such as symmetrical or near symmetrical facades, classical proportioning with a clearly defined base; detailing and ornamental relief; and simple overall form. (p. 6-16)

The code then includes detailed standards and guidelines for each element of the building facade, including material types, the base, facade elements, windows, doors, roofs, and color. The standards for the commercial and mixed-use buildings alone occupy eight pages of the codes.

By contrast, the Petaluma codes divide the code district into areas that constitute a street corridor. The codes describe (in one page for each area) the existing building patterns for that street (including several photos of the existing conditions) and the recommended design approach. The Architectural Guidelines in the Central Petaluma Specific Plan, Appendix B, described the existing pattern of the area along the Petaluma River as industrial, with simple warehouses and processing structures with gabled roofs, constructed of wood, brick, and metal.

The recommended design approach reads as follows:

Redevelopment, infill, and adaptive re-use in this area should adopt the existing patterns of simple building forms, industrial materials and utilitarian detailing. The Dairyman's and Hunt and Behrens structures have already introduced complex and random window patterns and angular forms to the area which could be adopted and elaborated to create unique architectural solutions. (p. 7)

The codes took very different approaches to standard-writing, some rely more on the interpretation of the professional designer and some giving exact parameters. The end result was that both produced walkable streets (figures 6-2D and 6-2E). The primary difference between the streets was the degree of complexity, which was affected by amount of detail and elements on the buildings and on the sidewalk.

### **Transferability of Form-Based Code Format**

The ability to transfer the UDQ models and the typical code format to FBCs for other types of streets will depend primarily on the goals and objectives of the codes. The UDQ models are appropriate for other types of streets, such as low density residential streets, because the design qualities can be applied to many conditions. For example, imageability and complexity may still be important for a residential street, but the types, numbers, and frequency of the features, which are important for the street, may be different. It is also likely that the stratification of the UDQs will be different for residential streets, and the emphasis may be placed on different models. Although imageability continues to be relevant, human scale and enclosure may be more

important for than complexity for the activities that take place on a residential street. The format of the FBCs is flexible enough that they can be written to fit many conditions. For instance, the codes may have to include an additional zone for the front yard. This may require new features in each UDQ model that are more specific to a front yard, such as plant material, mailboxes, driveways, and parked cars. However, the basic concepts, such as the ability to describe and measure the feature, remain the same.

### **Cultural Considerations**

Several difficulties arise with trying to determine the influence of culture on perceptual qualities as they relate to walkability. One difficulty is the definition of a “street”, which varies with cultures. In some cultures, “street” may be difficult to define morphologically and in others it is difficult to define by function. The common notion of a street in different cultures may not be adequate to define the setting that is necessary for code development. Because the uses of the street--those activities that take place in the street--vary widely, the rules of appropriate behavior will have a bearing on the form of the built environment.

Studies by Rapoport (1991) have shown that even a high variety of characteristics and pedestrian activities can be described in two categories: dynamic pedestrian behavior and static pedestrian behavior. The dynamic pedestrian behavior, which consists primarily of walking, is constant in nature and not highly affected by culture. Culture will typically influence the acceptability of walking, who walks with whom, and the pace, but not the reason for walking. However, static pedestrian behavior, which includes other activities, such as sitting, eating, and playing in the street, does vary greatly by culture and will have a greater influence on the use of the street.

Rapoport (1991) gives the comparison of highly public streets and semi-private streets in India. In the public streets a great variety of people are engaged in many different activities such as walking, sleeping, cooking, eating, doing laundry, and getting a haircut. On the semi-private streets in high status areas, where only residents have access, these activities, with the exception of walking, are confined to the buildings. This is a reflection of the differences in the traditions of the indigenous and colonial India, with the streets in high status areas being comparable to streets in Britain and the United States.

Another cultural issue that relates to walking is the visual aspect of the street. Studies by Rapoport (1991) also showed that the visual characteristics of the street did not affect walking behavior among cultures. But other characteristics that affect different senses, such as noise, smells, and movement, did affect cultural preferences for walking and other activities. Because my study focused on walking (dynamic pedestrian behavior) as it relates to the visual quality of the street, cultural differences were not considered in the assessment of the codes. Rapoport (1991) said that the most supportive environment for walking for many cultures is a perceptually complex environment with high levels of interest. The importance of a complex environment supports the use and the value of the UDAQs of complexity and imageability to assess a street for walking.

### **Summary and Recommendations**

The results and conclusions of my study have general application in several fields, particularly for planners and designers, who are writing more codes based on aesthetics and form to help communities make their towns more walkable. Information from my study provides a basis for code development for planners and a reference for walkable street design for landscape architects and architects. Recommendations for the development and use of codes include:

- Codes should strive to regulate a high number of features and control the frequency of the features within a designated length of the street.
- The majority of the features that the codes regulate should be linked to the UDQs of imageability, complexity, and human scale.
- The less precise features of the UDQs can be indirectly regulated by regulating combinations of more definable features that together create the desired feature.
- Codes should include descriptive narratives to show how combinations of features relate and work together to create a particular design feature or quality.
- Codes should also use narratives to describe the desired experience of the user. Narratives may help the designer apply the code more successfully.
- Codes should use illustrative narratives to describe the intent or rationale for a guideline. Narratives may give the designer a better understanding of the context and improve the administration of the code.
- Codes can demonstrate the overall effect of clusters of features by linking features to zones on the street, such as the building facade, sidewalk, and street.
- The codes should be most prescriptive with building materials and bulk provisions for the façade zone, street furniture in the sidewalk zone, and spatial dimensions for both the sidewalk and street zones. They can be more flexible on the type of building details and ornamentation.
- Codes should use a format that allows for the best interpretation and regulation of the UDQs and features that are most relevant to their stated goals and objectives.

The results show that Form-Based codes are a planning tool that communities can use with reasonable assurance to meet their goals for a more walkable community. The results from my study may also be useful for writing zoning and planning laws and legal policy for the regulation of aesthetics or physical character in a community.

Several contributions have been made to the body of knowledge in the design and environmental psychology fields. Ewing et al. (2005) developed the walkable street audit and made it available to researchers for further testing and evaluation. Using the audit as the basis for my study provided the opportunity to further investigate the urban design qualities and features for a walkable urban street. It was discovered certain qualities and features may be more or less

important for describing a walkable street. Qualities that appear more important for predicting a walkable street include imageability, complexity, and human scale, and those that appear less important include enclosure and transparency. Within the qualities, important features include: building details, materials, color and size, windows, street trees, street furniture, landscaping, parked cars, and street and sidewalk dimensions. My study also suggests that the concept--that physical design features related to walkability can be quantified, described and interpreted to create a desired outcome-- is a reasonable concept.

### **Tables of Recommended Features by Zones**

Tables 6-1 to 6-4 list the urban design features that are recommended to be included in Form-Based codes or used by designers in the development of walkable streets. Each table addresses a different area or zone in the street. The features are also grouped, in order of importance based on frequency of regulation in the codes and frequency of citation by users, under the UDQs that they most influence. The grouping is intended to help the writers and designers choose features based on the urban design quality that they influence. The tables include: the building facade zone, sidewalk and public space zone, street zone, and landscaping.

Table 6-1. Building façade zone

Recommended features to regulate for building facades	
<b>Imageability</b>	
historic architecture	pilasters
vernacular architecture	bulkheads
building type (esp. landmarks)	parapets
architectural style	turrets, towers
facade composition (detailing)	light fixtures
ornamental relief (moldings, trim, medallions)	upper story setbacks
building colors	downspouts and scuppers
quality building materials	
roof types, styles	
building signs, painted signs	
cornice, parapet with cornice cap	
proportioning	
<b>Complexity</b>	
patterns of moldings, trim, medallions	exposed rafters and beams
patterns of building entrances	decorative panels
window placement patterns	
building change in depth of plane	
individual roofs at storefronts	
marquees, sign bands	
metal downspouts and scuppers	
<b>Human Scale</b>	
maximum and minimum building heights	building proportions
maximum and minimum building widths	front porches, stoops
appurtenances beyond height limit	
<b>Enclosure</b>	
cloth/canvas awnings, overheads	
colonnades	
arcades	
balconies	
<b>Transparency</b>	
transparent glass	storefront window shapes, display space
continuous street wall	transom windows
percent fenestration on the facade	bay windows
window proportions and size	space between buildings
window placement patterns	spacing of entryways

Table 6-2. Sidewalk and public space zone

Recommended features to regulate for sidewalk and public space zones		
<b>Imageability</b>		
street trees	textured sidewalk	tree grates
public art	murals	gateway features
fountains	mosaics	
materials, locations for signs	bus shelters	
small planters	kiosks	
raised planters	manhole covers	
in ground planters	stormwater grates	
landmarks		
<b>Complexity</b>		
materials, locations for signs	small planters	kiosks
public art	textured sidewalk	drinking fountain
fountains	paving patterns	infrastructure/utilities
murals	tables, chairs, and umbrellas	parking meters
mosaics	bus shelters	mailboxes
<b>Human Scale</b>		
street trees	bike racks	drinking fountain
street furniture	trash receptacles	mailboxes
pedestrian lights, street lights	bollards	curb extensions
plazas	banner poles, banners, flags	crosswalks
parks	bus shelters, shade structures	newspaper racks
courtyards	kiosks	
<b>Enclosure</b>		
street trees	width of sidewalk clear zone	scale and mass to match
garden walls	setbacks, build-to-lines	existing buildings
fences	side setbacks	maximum and minimum lot
courtyard entrances	upper story setbacks	widths
sidewalk width	lot areas	
<b>Transparency</b>		
plazas	fences	
parks	maximum and minimum	
courtyards, courtyard entrances	building widths	
garden walls	midblock passageways	

Table 6-3. Street zone

Recommended features to regulate for street zone	
<b>Imageability</b>	
traffic lights	
parked cars	
traffic speed	
pavement markings	
<b>Complexity</b>	
textured street	curb cuts
paving materials	traffic speed
parked cars	bicycle lanes
parking bay types and dimensions	parking structures
<b>Human Scale</b>	
street width	pedestrian refuge islands
median width	ROW width
trees in landscaped median	crosswalk width
parallel and diagonal parking	traffic lights
<b>Enclosure</b>	
terminated vistas	median width
street width	ROW width
trees in landscaped median	traffic lights
parallel and diagonal parking	curb extensions
pedestrian refuge islands	
<b>Transparency</b>	
street connections to elsewhere	
driveway approaches	
alleyways	
marked crosswalks	
ROW width	

Table 6-4. Landscaping

Recommended features to regulate for landscaping	
<b>Imageability</b>	
street trees (spacing and type)	plant types
trees in wells/landscaped beds	terminated vistas
trees in planters	tree grates
major landscape features	landscaped median
<b>Complexity</b>	
plant types	
terminated vistas	
major landscape features	
<b>Human Scale</b>	
minimum sizes for planters	trees in planters
minimum number of trees in a public space	proportion of sidewalk shaded
plant size	landscape buffer width
street trees (spacing and type)	pedestrian refuge islands
trees in wells/landscaped beds	
<b>Enclosure</b>	
street trees (spacing and type)	
trees in wells/landscaped beds	
trees in planters	
landscape buffer width	
trees in planters	
proportion sidewalk shaded	
<b>Transparency</b>	
street trees (spacing and type)	
terminated vistas	
major landscape features	
plant size	



A



B



C



D

Figure 6-1. Urban design qualities: sidewalk features. A) Storefront bench, Kentucky Street, Petaluma. B) Building facade, First Street, Livermore. C) Outdoor dining, Healdsburg Avenue, Healdsburg. D) Courtyard, Castro Street, Mountain View.



A



B



C



D



E

Figure 6-2. Urban design qualities: street features. A) Continuous street wall, First Street, Livermore. B) Long sight line, South Santa Cruz Avenue, Los Gatos. C) Shop windows, University Avenue, Palo Alto. D) Complexity of street, 2<sup>nd</sup> Street, Petaluma. E) Complexity of street, First Street, Livermore

## CHAPTER 7 FUTURE WORK

The exploratory nature of my study leaves some questions about the use of Form-Based codes to create walkable urban streets unanswered. However, it does provide a structure for future studies and reasonable assurance that Form-Based codes are a zoning and planning tool with a realistic potential to create an enhanced pedestrian-oriented environment. My study is only the beginning of what could be many studies of FBCs as they relate to walkable streets.

### **Study Limitations**

The relative newness of FBCs was a limiting factor in this study. Very few communities have written FBCs and even fewer have adopted and implemented the codes. Most of the codes, which may be adopted in the next few years, will still take several years to be implemented, and so this time element provides an excellent opportunity for “before and after” long-term research. Cities that implement FBCs often do so in an area with distinct boundaries that make a limited and well-defined study area. The changes made to the area are usually very dramatic, making them easy to recognize, delineate, measure, and quantify--again, an ideal condition for research.

The FBC streets surveyed in my study were very new. One had small areas still under construction and others had obvious signs of “newness” including buildings that were not fully occupied by the intended users and small street trees that were barely visible in the landscape. This newness was a factor in the measurement of some of the audit features, for example, long sight lines were affected by lack of a tree canopy.

The interviews that were done with the users of the streets were limited to one community and two streets. It would be helpful to have different perspectives from people in other communities as each of the FBC streets and the historic streets had different qualities and characteristics. It would also be beneficial to interview other users besides those who have

businesses along the street. Several of the interview participants noted that they come to the street so often that they do not really notice details anymore. Plus several of the interviewees expressed perspectives that only a business owner would have, based on merchandise display and access to their business. A fresh look at the street by an infrequent user may offer a different perspective.

Some of the FBC streets had features that were not regulated by the codes. Although unregulated features presented the opportunity to note features that should be added to the codes, it was sometimes difficult to ascertain how much influence the codes actually had without carefully separating out the non-code items. Some features may have been, and in some cases were, regulated by other codes. Other features may have been included by the designer, or someone simply took it upon himself to place items in the sidewalk or street.

The urban design features used in this study were those hypothesized and validated by the Ewing et al. (2005) study. While the study was a well-designed, rigorous study by highly respected individuals in the field, it was the only study used to form the foundation of my study. Few studies are available on design features of walkable streets, but others, as they evolve may provide a different perspective on the features that should be considered in analyzing walkability.

### **Urban Design Qualities and Features**

Recommended future work falls into three categories: (a) research relating to the urban design features on walkable streets; (b) research relating to walkable street audits; and (c) analysis of Form-Based codes and the streets created through the codes. Three questions related to urban design features include: (a) What are the optimal numbers and combinations of features?; (b) What are the best methods for measuring and quantifying features?; and (c) What is the best format to codify the features? The optimum number of features within defined boundaries or a set distance is not known. In the FBCs the optimum number is usually related to

minimum and maximum distances or percentages, such as maximum building frontage or minimum percent of windows on the ground floor. However, the number of features, such as pedestrian lights, benches, trash cans, and trees, is typically left to the designer.

The ability to measure and quantify features is a concern that needs further research. The current research limits measurement to counts and percentages. Only those features which can be numerically counted or determined by percentage of area or space can be used to determine walkability. Other methods to “measure” features need to be determined and some features that are too difficult to measure may be essential to a walkable street. So the question remains: How to describe and account for “un-measurable” features in the audit format?

Two other issues with using urban design qualities and models are the overlap of the features and the interconnectedness of the models. Street trees, for example, may contribute to several qualities, but the quality in which they are most relevant is difficult to determine. Interconnectedness presents a quandary when trying to place features in the most relevant model, describe the optimum features, or create a hierarchy of UDQ models and related features to produce an accurate model.

Further research is needed on the features to include in a walkable street audit. The features in the audit were only those validated in the Ewing et al. (2005) study. However, the review of FBCs and the comments of the interview participants (which gave the average users perspective rather than the expert perspective) point to other measurable features that should be considered. These features could be added to the existing audit and tested using a number of case studies.

### **Form-Based Codes**

The format of FBCs is another area that merits attention. Some codes are written with a good deal of flexibility and others are very specific and detailed in their approach. It would be interesting to study the different formats by auditing streets developed from each format and

comparing audit scores. It is necessary to continue to study and monitor streets that are created through the use of FBCs. Many different street “styles” will emerge from the use of codes, and some may prove to be more effective than others. These studies could be used to fine-tune the writing and development of FBCs. Researchers should study these streets over time to see if the concepts of the codes withstand the test of time and become as durable as the historic streets they are modeled after.

## LIST OF REFERENCES

- Addy, C. L., Wilson, D. K., Kirtland, K. A., Ainsworth, B. E., Sharpe, P., & Kimsey, D. (2004). Associations of perceived social and physical environmental supports with physical activity and walking behavior. *American Journal of Public Health, 94*(3), 440-443.
- Alexander, C., Ishikawa, S., Silverstein, M., Jacobson, M., Fiksdahl-King, I., & Shlomo, A. (1977). *A pattern language: Towns, buildings, construction*. New York: Oxford University Press.
- Appleton, J. (1975). *The experience of place*. London: Wiley.
- Appleyard, D. (1981). *Livable streets*. Berkeley, CA: University of California Press.
- Arnold, H. (1993). *Trees in urban design*. New York: Van Nostrand Reinhold.
- Ashihara, Y. (1970). *Exterior design in architecture*. New York: Van Nostrand Reinhold.
- Ataov, A. (1998). Environmental aesthetics. *Journal of Planning Literature, 13*(2), 239-257. Retrieved March 18, 2007, from <http://jpl.sagepub.com>
- Berlyne, D. (1971). *Aesthetics and psychobiology*. New York: Meredith.
- Boslaugh, S. E., Luke, D. A., Brownson, R. C., Naleid, K. S., & Kreuter, M. W. (2004). Perceptions of neighborhood environment for physical activity: Is it "who you are" or "where you live"? *Journal of Urban Health, 81*(4), 671-681.
- Brownson, R. C., Chang, J. J., Eyler, A. A., Ainsworth, B. E., Kirtland, K. A., Saelens, B. E., & Sallis, J. F. (2004). Measuring the environment for friendliness toward physical activity: A comparison of the reliability of 3 questionnaires. *American Journal of Public Health, 94*(3), 473-483.
- Burden, D. (2006). Urban street trees: 22 benefits, specific applications. Retrieved February 14, 2008, from <http://www.walkable.org/download/22-benefits.pdf>
- Carnegie, M. A., Bauman, A., Marshall, A. L., Mohsin, M., Westly-Wise, V., & Booth, M. L. (2002). Perceptions of the physical environment, stage of change for physical activity, and walking among Australian adults. *Research Quarterly for Exercise and Sport, 73*(2), 146-155.
- Carr, S., Francis, M., Rivlin, L. G., & Stone, A. M. (1992). *Public space*. Cambridge, UK: Cambridge University Press.
- Clemente, O., Ewing, R., Handy, S., & Brownson, R. (n.d.). *Measuring urban design qualities related to walkability: An illustrated field manual*. Retrieved April. 12, 2007, from <http://www.activelivingresearch.org/node/10635>

- Cullen, G. (1961). *The concise townscape*. London: Reed Educational and Professional Publishing.
- Curran, R. J. (1983). *Architecture and the urban experience*. New York: Van Nostrand Reinhold.
- Dannenber, A. L., Jackson, R. J., Frumkin, H., Schieber, R. A., Pratt, M., Kochtitzky, C., & Tilson, H. H. (2003). The impact of community design and land use choices on public health: A scientific research agenda. *American Journal of Public Health, 93*(9), 1500-1508.
- Downs, R., & David. S. (Eds.). (1973). *Image and environment: Cognitive mapping and spatial behavior*. Chicago: Aldine.
- Doyle, S., Kelly-Schwartz, A., Schlossberg, M., & Stockard, J. (2006). Active community environments and health: The relationship of walkable and safe communities to individual health. *Journal of the American Planning Association, 72*(1), 19-31.
- Duerksen, C. (1992). Zoning for aesthetics. *Taking a Closer Look: Design and Aesthetics. Planning Commissioners Journal Special Collection, 31-33*.
- Echeverria, S. E., Diez-Roux, A. V., & Link, B. G. (2004). Reliability of self-reported neighborhood characteristics. *Journal of Urban Health, 81*(4), 682-701.
- Evans, T. (Ed.). (1987). *The Stanford health and exercise handbook*. Champaign, IL: Stanford Alumni Association and Leisure Press.
- Ewing, R., Clemente, O., Handy, S., Brownson, R., & Winston, E. (2005). *Identifying and measuring urban design qualities related to walkability, Final report*. Retrieved April 12, 2007, from <http://www.activelivingresearch.org/node/10636>
- Ewing, R., Frank, L., & Kreutzer, R. (2006). Understanding the relationship between public health and the built environment: A report prepared for the LEED-ND Core Committee. Retrieved July 13, 2007, from [www.usgbc.org/showfile.aspx?DocumentID=1736](http://www.usgbc.org/showfile.aspx?DocumentID=1736)
- Ewing, R., Handy, S., Brownson, R., Clemente, O., & Winston, E. (2006). Identifying and measuring urban design qualities related to walkability. *Journal of Physical Activity and Health, (Suppl. 1)*, 223-240.
- Ewing, R., Schmid, T., Killingsworth, R., Zlot, A., & Raudenbush, S. (2003). Relationship between urban sprawl and physical activity, obesity, and morbidity. *American Journal of Health Promotion, 18*(1), 47-57.
- Ford, L. R. (2000). *The spaces between buildings*. Baltimore: The John Hopkins University Press.

- Frank, L. D., Anderson, M., & Schmid, T. (2004). Obesity relationships with community design, physical activity, and time spent in cars. *American Journal of Preventive Medicine*, 27(2), 87-96.
- Frank, L. D., Engelke, P.O., & Schmid, T. L. (2003). *Health and community design: The impact of the built environment on physical activity*. Washington, DC: Island Press.
- Frank, L. D., Schmid, T., Sallis, J. F., Chapman, J., & Saelens, B. (2005). Linking objectively measured physical activity with objectively measured urban form: Findings from SMARTRAQ. *American Journal of Preventive Medicine*, 28(Suppl. 2), 117-125.
- Frumkin, H., Frank, L., & Jackson, R. (2004). *Urban sprawl and public health: Designing, planning, and building for healthy communities*, Washington, DC: Island Press.
- Gibson, J. (1979). *The ecological approach to visual perception*. Boston: Houghton Mifflin.
- Giles-Corti, B., & Donovan, R. J. (2003). Relative influences of individual, social environmental, and physical environmental correlates of walking. *American Journal of Public Health* 93(9), 1583-1589.
- Gill, T. (2002). Importance of preventing weight gain in adulthood. *Asia Pacific Journal Clinical Nutrition*, 11(Suppl.), S632-S636.
- Groat, L. N. (1989). Contextual compatibility in architecture: An issue of personal taste? In J. L. Nasar (Ed.), *Environmental aesthetics: Theory, research, and applications* (pp. 228-253). Cambridge, UK: Cambridge University Press.
- Handy, S., Boarnet, M., Ewing, R., & Killingsworth, R. (2002). How the built environment affects physical activity: Views from urban planning. *American Journal of Preventive Medicine*, 23(Suppl. 2), 64-73.
- Hill, J., Wyatt, H., Reed, G., & Peters, J. (2003). Obesity and the environment: Where do we go from here? *Science*, 299(5608), 853-855.
- Hedman, R. (1984). *Fundamentals of urban design*. Chicago: Planners Press.
- Hoehner, C., Brennan Ramirez, L., Elliot, M., Handy, S., & Brownson, R. (2005). Perceived and objective environmental measures and physical activity among urban adults. *American Journal of Preventive Medicine* 28(2S2), 105-116.
- Jackson, J. R. (2003). The impact of the built environment on health: An emerging field. *American Journal of Public Health*, 93(9), 1382-1384.
- Jacobs, A. (1993). *Great streets*. Cambridge, MA: MIT Press.
- Jacobs, A., & Appleyard, D. (1987). Toward an urban design manifesto. *Journal of the American Planning Association*, 5, 112-120.

- Kaplan, R., & Kaplan, S. (1989). *The experience of nature: A psychological perspective*. Cambridge, UK: Cambridge University Press.
- Kaplan, S., Kaplan, R., & Wendt, J. S. (1972). Rated preference and complexity for natural and urban visual material. *Perception and Psychophysics*, 12, 354-56.
- Katz, P. (2004). Form first, the new Urbanist alternative to conventional zoning. Retrieved July 8, 2007, from [www.formbasedcodes.org](http://www.formbasedcodes.org)
- Koch, T. (2005). *Cartographies of disease: Maps, mapping, and medicine*. Redlands, CA: ESRI Press.
- Lang, J. (1987). *Creating architectural theory: The role of the behavioral sciences in environmental design*. New York: Van Nostrand Reinhold.
- Lennard, S. H. C., & Lennard, H. L., (1987). *Livable cities-people and places: Social and design principles for the future of the city*. Southhampton, NY: Center for Urban Well-Being.
- Leslie, E., B. Saelens, B., Frank, L., Owen, N., Bauman, A., Coffee, N., & Hugo, G. (2005). Residents' perceptions of walkability attributes in objectively different neighborhoods: A pilot study. *Health & Place*, 11(3), 227-236.
- Lewis, M. (2004). Form-Based zoning. Retrieved July 8, 2007, from <http://denvergov.org/ZoningSimplification/template318115.asp?cview=2>
- Lopez, R. (2004). Urban sprawl and the risk for being overweight or obese. *American Journal of Public Health*, 94(9), 1574-1579.
- Lynch, K. (1960). *The image of the city*. Cambridge, MA: Massachusetts Institute of Technology Press.
- Marcus, C. C., & Francis, C. (Eds.). (1990). *People places: Design guides for urban open space*. New York: Van Nostrand Reinhold.
- McArdle, W., Katch, F., & Katch, V. (1981). *Exercise physiology: Energy, nutrition, and human performance*. Philadelphia: Lea & Febiger.
- McCann, B., & Ewing, R. (2003). *Measuring the health effects of sprawl: A national analysis of physical activity, obesity and chronic disease*. Retrieved June 3, 2007, from [http://www.sactaqc.org/Resources/Literature/Public\\_Health/HealthSprawl.pdf](http://www.sactaqc.org/Resources/Literature/Public_Health/HealthSprawl.pdf)
- Moore, G. (1979). Knowing about environmental knowing: The current state of theory and research on environmental cognition. *Environment and Behavior* 11(1), 33-70.
- Moughtin, C. (1992). *Urban design: Street and square*. Amsterdam: Architectural Press.
- Nasar, J. (1987). The effect of sign complexity and coherence on the perceived quality of retail scenes. *Journal of the American Planning Association*, 53(4), 499-509.

- Nasar, J. (1994). Urban design aesthetics: The evaluation qualities of building exteriors. *Environment and Behavior*, 26(3), 377-401.
- Nasar, J. (1997). The evaluative image of the city. *Journal of the American Planning Association*, 56(1), 41-57.
- Nelessen, A. (1994). *Visions for a new American dream*. Washington, DC: American Planning Association.
- Northridge, M., & Sclar, E. (2003). A joint urban planning and public health framework: Contributions to health impact assessment. *American Journal of Public Health*, 93(1), 118-121.
- Orr, F. (1985). *Scale in architecture*. New York: Van Nostrand Reinhold.
- Owen, N., Humpel, N., Leslie, E., Bauman, A., & Sallis, J. F. (2004). Understanding environmental influences on walking: Review and research agenda. *American Journal of Preventive Medicine*, 27(1), 67-76.
- Paumier, C., Ditch, W. S., Dimond, C., & Rich, D. P. (1988). *Designing the successful downtown*. Washington, DC: Urban Land Institute.
- Perdue, W. C., Stone, L. A., & Gostin, L. O. (2003). The built environment and its relationship to the public's health: The legal framework. *American Journal of Public Health*, 93(9), 1390-1394.
- Peters, J. (2004). Social change and obesity prevention: Where do we begin? *Nutrition Today*, 39(3), 112-117.
- Pierce, N. (2003). Zoning: Ready to be reformed? Retrieved March 14, 2006, from <http://www.postwritersgroup.com/archives/peir0127.htm>
- Pikora, T., Giles-Corti, B., Bull, F., Jamrozik, K., & Donovan, R. (2003). Developing a framework for assessment of the environmental determinants of walking and cycling. *Social Science and Medicine* 56, 1693-1703.
- Porteous, J. D. (1996). *Environmental aesthetics: Ideas, politics and planning*. New York: Routledge.
- Pucher, J., & Dijkstra, L. (2003). Promoting safe walking and cycling to improve public health: Lessons from the Netherlands and Germany. *American Journal of Public Health*, 93(9), 1509-1516.
- Purcell, A. (1986). Environmental perception and affect: A schema discrepancy model. *Environment and Behavior*, 18(1), 3-30.
- Rapoport, A. (1990). *History and precedent in environmental design*. New York: Plenum Press.

- Rapoport, A. (1991). Pedestrian street use: Culture and perception. In A. V. Moudon (Ed.), *Public streets for public use* (pp. 80-91). New York: Columbia University Press.
- Reed, J. A., Ainsworth, B. E., Wilson, D. K., Mixon, G., & Cook, A. (2004). Awareness and use of community walking trails. *Preventive Medicine, 39*, 903-908.
- Rubenstein, H. (1992). *Pedestrian malls, streetscapes, and urban spaces*. New York: John Wiley & Sons.
- Saelens, B. E., Sallis, J. F., Black, J. B., & Chen, D. (2003). Neighborhood-based differences in physical activity: An environment scale evaluation. *American Journal of Public Health 93*(9), 1552-1558.
- Sallis, J. F., Bauman, A., & Pratt, M. (1998). Environmental and policy interventions to promote physical activity. *American Journal of Preventive Medicine, 15*(4), 379-397.
- Schilling, J. S., & Linton, L. S. (2005). The public health roots of zoning: In search of active living's legal genealogy. *American Journal of Preventive Medicine, 28*(2 Suppl. 2), 96-104.
- Schmitz, A., & Scully, J. (2006). *Creating walkable places*. Washington, DC: Urban Land Institute.
- Smith, P. (2003). *The dynamics of delight: Architecture and aesthetics*. London: Routledge.
- Southworth, M. (2005). Designing the walkable city. *Journal of Urban Planning and Development, 131*(4), 246-257.
- Stamps, A. E. III, (1998). Measures of architectural mass: From vague impressions to definite design features. *Environment and Planning, 25*, 825-836
- Stamps, A. E., III. (2000). *Psychology and the aesthetics of the built environment*. Boston: Plenum Press.
- Stokes, R., Moore, A. C., & Moore, C. (1988). *Fitness: The new wave*. Winston-Salem, NC: Hunter Textbooks.
- Ulrich, R. (1983). Aesthetic and affective response to natural environments. In I. Altman & J. F. Wohlwill (Eds.), *Human behavior and environment: Advances in theory and research*, (pp. 85-125). New York: Plenum Press.
- Unwin, S. (2003). *Analyzing architecture*. New York: Rutledge.
- U.S. Department of Health and Human Services. (1996). *Physical activity and health: A report of the Surgeon General*. Retrieved July 10, 2007, from <http://www.cdc.gov/nccdphp/sgr/sgr.htm> .

- Van der Laan, H. (1983). *Architectonic space: Fifteen lessons on the disposition of the human habitat*. The Netherlands: E. J. Brill.
- Ward, F., & Russell, J. (1981). The psychological representation of molar physical environment. *Journal of Experimental Psychology: General*, 110(2), 121-52.
- Watson, I. (2001). An introduction to design guidelines. *Taking a closer look: Design and aesthetics. Planning Commissioners Journal Special Collection*, 9-13.
- Wohlwill, J. (1976). Environmental aesthetics: The environment as a source of affect. In I. Altman & J. F. Wohlwill (Eds.), *Human behavior and environment: Advances in theories and research*. New York: Plenum Press.
- Zacharias, J. (2001). Pedestrian behavior and perception in urban walking environments. *Journal of Planning Literature*, 16(1), 3-18.
- Zube, E. H., Sell, J. L., & Taylor, J. G. (1982). Landscape perception: Research, application, and theory. *Landscape Planning*, 9(1), 1-33.

## BIOGRAPHICAL SKETCH

Gail Hansen was born in Fargo, North Dakota, and moved with her family shortly afterward to Lake Tahoe, California, where she attended primary and secondary schools. She graduated with a Bachelor of Arts degree in physical education from California State University, Sacramento, and a Master of Science degree in exercise physiology from the University of Arizona. She worked in the health and wellness field from 1980 to 1990, first in the Los Angeles area and then for eight years at the Obesity Treatment Center, Sutter Community Hospital, Sacramento. In 1990, she moved to Gainesville, Florida, where she graduated with a Master of Landscape Architecture degree in 1994. She worked from 1994 to 2000 for a private landscape architecture firm, Buffington Associates, in Gainesville and then became an adjunct instructor at the University of Florida in the Landscape Architecture Department. While teaching at the university, she began her doctorate degree studies in landscape architecture in 2004. In January 2008, she accepted an assistant professor position in the Environmental Horticulture Department at the University of Florida where she is teaching landscape design.