Urban Planning/Design Elements that Contribute to Making a Vibrant Commercial Street

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Urban Planning/Design Elements that Contribute to Making a Vibrant Commercial Street

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Chapter 1: Introduction

This chapter provides the background and relevant information on the research topic: "vibrant commercial streets". This chapter contains four sub-sections which are "Background", "Research Question", "Relevance of the Research", and "Overview of the Report". In "Background" section, the author presents a general introduction to the research topic; two specific research questions are raised in "Research Question" section; in "Relevance of the Research" section, the author talks about the importance of conducting this research; and the structure of the report is described in "Overview of the Report" section.

a) Background

Streets play an important role in the public space in urban areas. In old days people utilized the streets for basic needs of survival such as shopping and dining, human interaction, leisure activities as well as for other purposes such as political, religious and commercial uses (Lofland 1998; Mehta 2009, 29) (see Figure 1). Since then, many functions of the streets have been transferred to private or virtual areas, or to other types of public spaces (Banerjee 2001, 14; Mehta 2009, 30). However, the people living in center cities or mixed-use neighborhoods still rely on streets for functional, social, and leisure activities such as traveling, shopping, entertainment, interaction with others, and relaxation (Southworth and Ben-Joseph 1995, 66; Mehta 2009, 30).

Figure 1: Main Street in the Late 19th Century, Canada (Looking North)

Source: http://farm6.static.flickr.com/5285/5201316569_1f0d4002b8_b.jpg (accessed April 22, 2011).

Downtown Davis provides pedestrian and bike-friendly street environments to the residents in the community and to the UC Davis campus for shopping, dining, and entertainment. The local businesses are highly crowded in Downtown Davis. There are approximately 750 retail, professional, and service businesses in the 32-block area (Davis Downtown Business Association 2010).

However, the vibrancy of each block/street is different even though they are located very close to each other (see Figure 2). There should be some elements that affect people's perception of the commercial streets and their choices of using them. Those elements are considered having direct influences on the vibrancy of the street because vibrancy (vitality) refers to "the numbers of people in and around the street (pedestrian flows) across different times of the day and night" (Montgomery 1998, 96).

The major purpose of this research is to identify the elements that contribute to

Figure 2: Comparison of Street Vibrancy - E St. (West Side) between 2nd and 3rd St. & F St. (West Side) between 2nd St. and Parking Lot

Source: Author

the street vibrancy, and to identify most important elements which could be improved or provided in order to enhance the street vibrancy of commercial streets in the downtown Davis core area.

Twelve commercial streets –A Street, University Avenue, B Street, C Street, D Street, E Street, F Street, G Street, Rice Ln Street, 2nd Street, 3rd Street, 4th Street in the downtown Davis core area are chosen for this research (more detailed information about study area is described in Chapter 4 of this report). Most streets are lined by commercial uses, and the street vibrancy varies among different blocks/ streets. The goal of the research is to provide possible suggestions for bringing more vibrancy to the center of downtown in order to improve the friendliness and healthy lifestyle that Davis is known for.

b) Research Question

This report focuses two research questions:

a) what are the urban planning and urban design elements that contribute to the vibrancy of the commercial streets in the downtown core area of Davis?" Further,

b) how can planners improve the vibrancy of commercial streets in the downtown core area of Davis by applying urban planning and urban design elements?

c) Relevance of Research

"… Think of a city and what comes to mind? Its streets. If a city's streets look interesting, the city looks interesting; if they look dull, the city looks dull …" (Jacobs 1993, 37). Streets are an important part of the "informal external public realm" (Carmona et al. 2003, 111), and have equal value to the building or the building block (Lillebye 1996). Particularly, planning and designing lively and diversified neighborhood commercial streets, which most people living in mixed-use neighborhoods are looking for (Brower 1996), is one of the most critical issues in the neighborhood planning (Mehta 2007, 30) (see Figure 3). It is extremely important to understand what elements contribute to making vibrant commercial streets for their users.

In this research, the author identified important elements that contribute to the street vibrancy in the specific geographic area - downtown area in Davis, California. Based on the previous research works, the author developed several methods for conducting street observation and analyzing data. For examples, the method introduced by Ewing et al. (2005 & 2006) which could quantify the qualities of physical elements, the one shown by Mehta (2007 & 2009) which could determine the liveliness of the public space, and the one developed by Sullivan, Kuo, and DePooter (2004) which describes how to observe activities on the public place are modified and used in this research (more detailed description about these researches is presented in Chapter 2 - Literature Review of this report). In addition, the author conducted a survey to understand the perception of streets users for future improvements.

There are multiple benefits of improving the public life on streets. Scholars suggest that if ". . . we do right by our streets we

Figure 3: Street View - Wokingham, Peach Street

Source: http://www.stephenpeart.co.uk/Portfolio%20Images/Wokingham,%20Peach%20Street%201.jpg (accessed April 22, 2011).

can in large measure do right by the city as a whole – and, most importantly, by its inhabitants" (Jacobs 1993, 314; Mehta 2009, 29). Understanding urban planning and design elements that contribute to the vibrancy of commercial streets could assist planners and decision makers to design and develop better street environments as well as better city features catering to various users. In addition, the study of how to promote the vibrancy of commercial streets will support revitalizing street life that has been eroded by the automobile-oriented suburbanization (Hinkelman 2001, 350; Engwicht 2001, 22-23). In summary, identifying and promoting the elements which make comfortable, interesting, and meaningful streets will enhance the quality of public life.

d) Overview of Report

The rest of this report is organized as follows. Chapter 2 reviews the literature and discusses the reason why streets are considered meaningful public places. Chapter 3 introduces the downtown core area of Davis, California which is the study area for this research. Chapter 4 focuses on the methods and findings of street observation and survey. Chapter 5 provides several recommendations for improving the vibrancy of the selected commercial streets. Chapter 6 presents conclusions and highlights areas for future research.

Chapter 2: Meaningful Public Spaces - Streets

This chapter discusses the reason why streets, especially commercial streets, are considered meaningful public places. This chapter contains two sections: "Literature Review" and "Meaningful Public Space- Commercial Street". The section titled "Literature Review" reviews existing research on the relationship among physical environment, people's behavior, and meanings of the public places/streets. The section titled "Meaningful Public Space- Commercial Street" describes the objective of studying the commercial streets in mixed- use neighborhoods.

a) Literature Review

What elements make one public place distinctive from others? Montgomery (1998) indicates that physical environment, people's behavior, and meanings of the public place are combined to form the sense of the public space. This section reviews existing research on the relationship among physical environment, people's behavior, and meanings of the public places. It is important to identify the critical physical environment attributes related to both people's behavior and meanings in order to improve street vibrancy.

Relationship between Physical Environment and Activity

Existing literature indicates that a wide range of physical environment is correlated with physical and social activity. Some researchers have investigated the relationship between physical environment and human activity without focusing on any specific attribute (Rapoport 1977; Lang 1987; Gehl 1987; Whyte 2001, Mehta 2007 & 2009).

Mehta (2007 & 2009), for instance, particularly worked on the connection between the physical environment and human activities on commercial streets. He developed a method to measure the responsiveness and diversity in the usability of the public space. A "Good Public Space Index" was used to determine the liveliness of the public space (Mehta, 2007). Six measurement indicators, which are the intensity of use, the intensity of social use, people's duration of stay, the temporal diversity of use, the variety of use, and the diversity of users, contributed to the Good Public Space Index. Later in 2009, he applied behavior mapping and user perception through interviews to study the connection between the physical environment and human activities. He found that physical, land use and social dimensions are most important elements that contribute to the livability of the neighborhood commercial streets. The study showed that an appropriate combination of physical settings, behavioral environment, and meanings could provide a desirable place to live.

Other researchers focus on the influences of specific physical elements on certain activities such as influence of street floor and spatial layout on street activities (Skjæveland 2001), influence of greenness on social activity (Sullivan, Kuo, and De-

Pooter 2004), and relationship between the physical environment and physical activities (Ewing et al. 2005 & 2006; Forsyth et al. 2007; Sugiyama et al. 2009).

Ewing et al. (2005 & 2006), for example, integrally investigated the qualities of physical environment on the people's perceptions of streetscapes. They developed an operational measurement protocol that could quantify the urban design qualities related to walking behavior. Five criteria, inter-rater reliability of scene ratings, relationships between physical features and urban design qualities, inter-rater reliability of measured features, and correlates of overall walkability were utilized to determine which of nine urban design qualities to measure in the final operation. Those nine urban design qualities were imageability, legibility, visual enclosure, human scale, transparency, linkage, complexity, coherence, and tidiness. Analyzing more than 200 clips filmed in dozens of cities around the United States, authors decided the qualities of imageability, enclosure, human scale, and transparency which met all five criteria as input physical qualities. The operational measurement protocol could objectively measure physical features of the environment to determine the urban design qualities that affect the individual's feeling about the street as a place to walk.

In addition, some researchers have focused on the dynamic elements that affect the street vibrancy and activities on the streets. For example, Manley and Malone suggested that the planners should take into account diversified groups of people such as youth and disabled persons in order to promote the street vibrancy (Manley 1996; Malone 2002). Moreover, some researchers investigated the effects of safe traffic and pedestrian-friendly street environment on the vibrancy (Appleyard 1981; Engwicht 2001; Dumbaugh 2005; Follmann 2007; Biddulph 2010; Better Street Plan San Francisco 2010).

Contributions of the Meaning to the User's Perception on the Public Place

Although much research has been conducted to investigate the relationship between the physical elements and the activity, relatively less effort has been made in pursuing the contributions of meaning and attachment to the public places (Brown, Perkins, and Brown 2003; Ryan 2005; Shamsuddin and Ujang 2008). Place attachments are "defined as the bonding established between people and

places" (Shamsuddin and Ujang 2008, 399).

Overall, the users' perception of the public place can be influenced not only by the quality of the physical elements and the intensity of activities but also by the attachment and the meanings of the place. It is therefore extremely important to understand the relationship among the physical environment, activity, and meaning in order to increase the street vibrancy.

b) Meaningful Public Space: Commercial Streets

"Mixed-use neighborhoods are predominantly residential neighborhoods that also include work, retail, culture and/or light industrial uses" (Mehta 2009, 30). Mixed-use neighborhoods typically have a core area of commercial streets that supports the greatest mix of uses and activities for the neighborhood (Mehta 2009, 30). A study showed that most people living in

Figure 4: Commercial Street View

Source: http://www.migcom.com/img/managed/Image/435/large_file.jpg (accessed April 12, 2011)

mixed-use neighborhoods are looking for a lively and diversified neighborhood commercial street (Brower 1996) (see Figure 4). Therefore planning and designing lively and diversified neighborhood commercial streets has become one of the most critical issues in the neighborhood planning (Mehta 2007, 3).

c) Human Behavior as a Basis for Design

To better plan and design commercial streets in mixed-use neighborhoods, it is necessary to understand the residents' needs. However it is relatively difficult to measure and quantify human needs; therefore, researchers use human behavior as a counterpart to human needs. The "behavior setting" mainly focuses on the study of the human behavior and the relationship with physical settings (Barker 1968).

There are some examples of research which mainly focused on studying fundamental theories about the "behavior setting." Rapoport (1977) studied the characteristics of people, the effects of the built environment on the human behavior, and the mechanisms that link people and the environment. Lang (1987) examined the relationship between a physical environment (setting) and the patterns of human behavior that may possibly take place. They found that better relationship between the particular physical environment and the human activities allows better support of human behaviors and needs.

On the other hand, environmental psychologists have developed research methods which involve studying real life situations and engaging common users of the environment. According to their study, observing human behavior is an effective way to study human behavior, human needs, and preferences (Michelson, 1975; Mehta 2009, 31). Therefore, to better understand the relationship between the environment setting and human behavior/ the needs, the author conducted observations of the commercial streets in downtown Davis core area. Specific description of the observation is introduced in Chapter 4 of this report.

Chapter 3: Study Area-Downtown Core Area in Davis, California

This chapter introduces the background information about the study area-downtown Davis core area. This chapter contains two sections: "Downtown Core Area in the City of Davis" and "Current Physical Conditions of the Study Area". In the first section, the author provides geographic and demographic information about the downtown Davis core area. The second section presents current physical conditions including land uses, blocks, streets, buildings, and parking of the downtown Davis core area.

a) Downtown Core Area in the City of Davis

The city of Davis is located 15 miles west of Sacramento, and 75 miles east of San Francisco (Davis Downtown Business Association) (see Figure 5). The area of downtown Davis core area is 0.175 square miles, and the population of downtown Davis is 279 in the year 2008 (Downtown Core Neighborhood in Davis, California (CA) Detailed Profile 2010).

Downtown Davis provides pedestrian and biking friendly street environments to the residents in the community and the University of California at Davis campus for needs of shopping, dining, and entertainment (see Figure 6 and 7). The local

Figure 5: Davis Location

Data Source: Geo Community. Designed by the author.

Figure 6: Farmers' Market in Davis Central Park

Source: http://t1.gstatic.com/images?q=tbn:ANd9GcS63WEkYhzsaeF0ZANQqaKjhY8AdXAF2w-rOFnjPR_4zE8rznWP3w (accessed December 01, 2010).

Figure 7: Street Users and Stores in Downtown Davis

Source: Davis Downtown Business Association, http://www.davisdowntown.com/ (accessed December 01, 2010).

businesses in Downtown Davis are highly crowded. There are approximately 750 retail, professional, and service businesses in 32 blocks (Davis Downtown Business Association 2010) (see Figure 8).

b) Current Physical Conditions of the Study Area

There are fourteen commercial streets –A Steet, University Avenue, B Steet, C Steet, D Steet, E Steet, F Steet, G Steet, Rice Ln Steet, 1st Street, 2nd Steet, 3rd Steet, 4th Steet, and 5th Street - in the downtown Davis core area (see Figure 8).

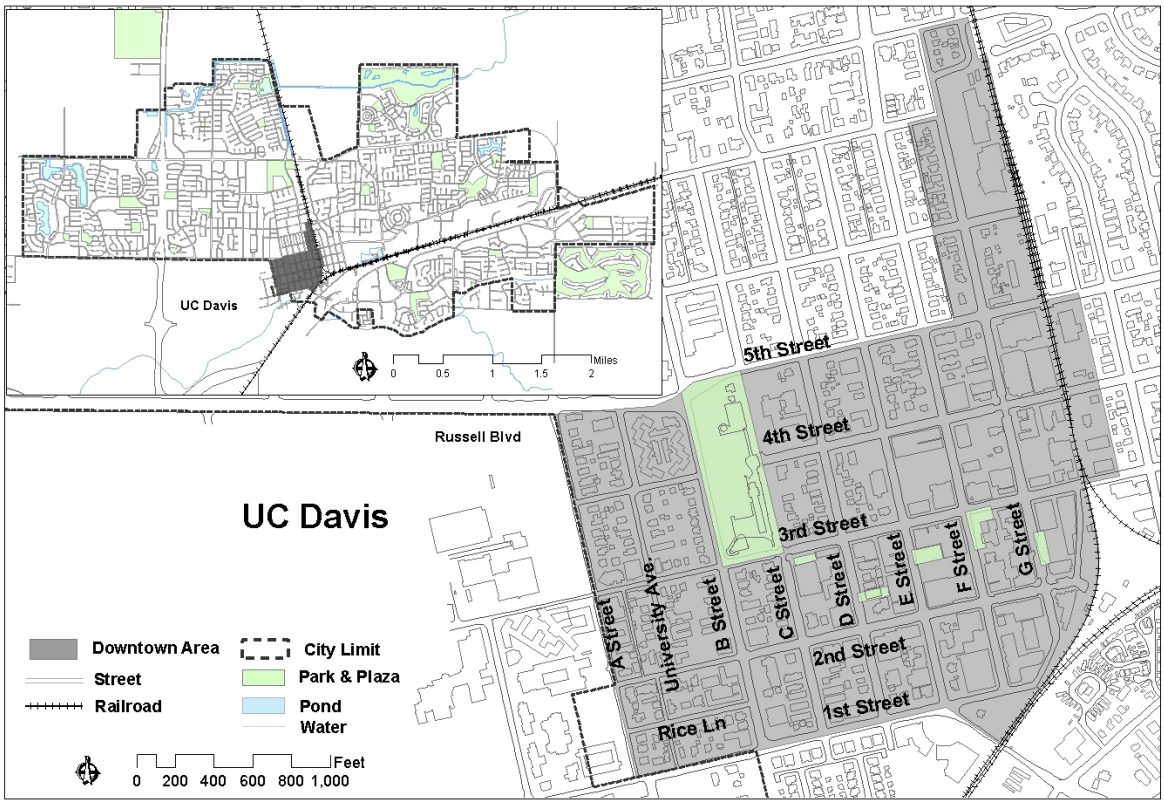


Figure 8: Commercial Streets in Downtown Davis Core Area

Data Source: City of Davis GIS Library, Metropolitan Transportation Commission GIS Data, Geo community, ArcGIS Resource Centers. Designed by the author.

Physical Characteristics of the Study Area

Land Uses: as shown in Figure 9, most streets are commercial in the downtown Davis core area. Majority of the commercial uses include restaurants, cafes, shopping stores, and offices. Other commercial uses contain movie theaters, hotels, art galleries, and Davis farmers' market and so on. In addition, there are residential uses (apartments and single family houses) and open spaces (parks and plazas) in the area.

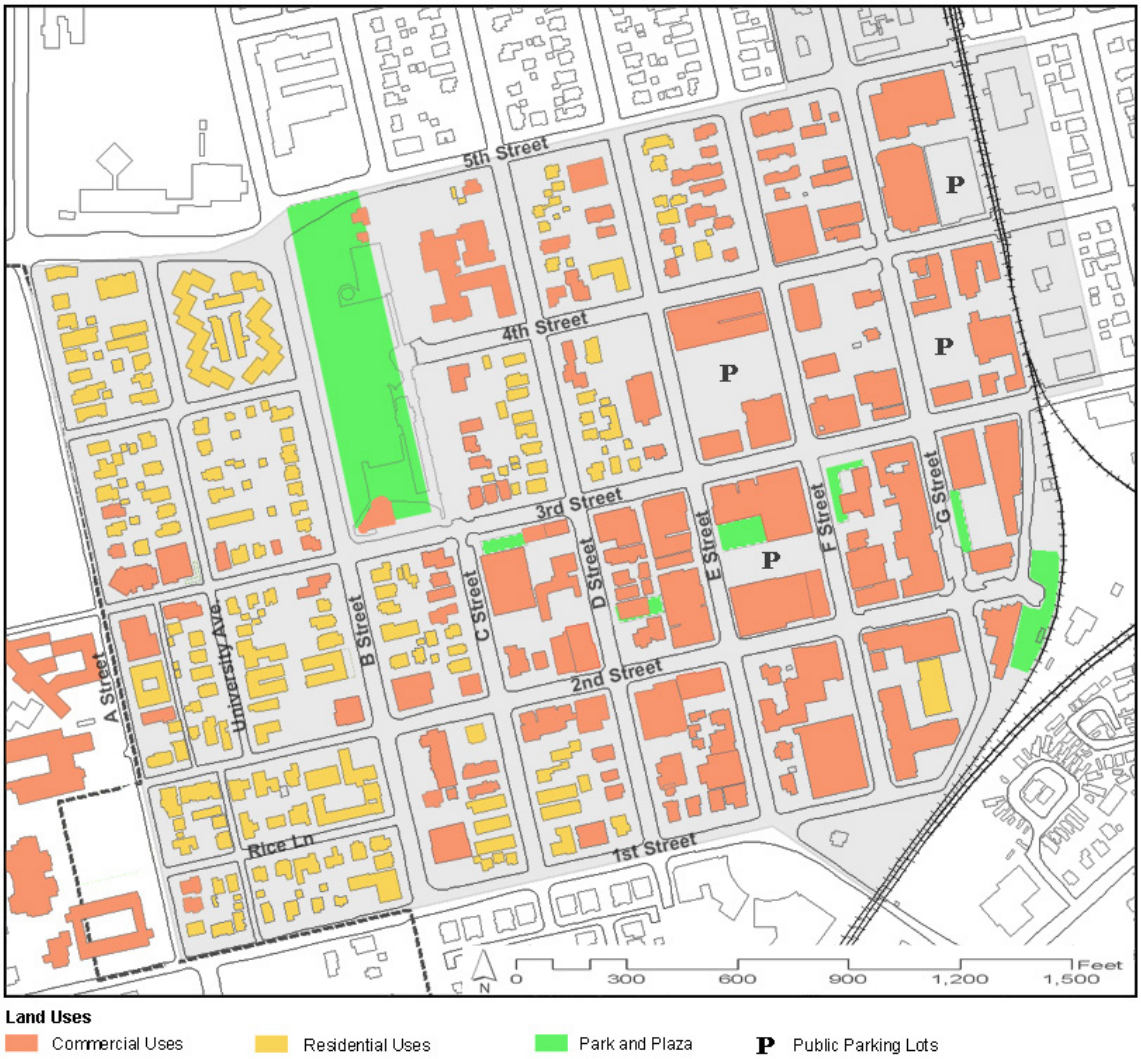


Figure 9: Land Uses in Downtown Davis Core Area

Data Source: City of Davis GIS Library, Metropolitan Transportation Commission GIS Data, street observation by the author. Designed by the author.

Blocks: there are 32 blocks in the downtown Davis core area, and the length of the block ranges from 200 to 824 feet (detailed information about the blocks is listed in Appendix A).

Street width and traffic: most streets in the downtown Davis core area have one traffic lane in each direction except for 1st, B, and 5th Streets. First and B streets have one lane in each direction, except in the portion near the intersection where it is changed into two lanes. Fifth Street has two lanes in each direction. The 3rd Street has bike lanes on both sides of the street (see Figure 10). The width of street right of way ranges from 42 to 98 feet. Stop signs are placed on most intersections in the downtown Davis core area, so the speed of traffic is relatively slow which provides pedestrian-friendly travel environment to the street users (detailed information about the blocks is listed on Appendix A) (Figure 11 shows an example of street section in the downtown Davis core area).

Figure 10: The 3rd Street with Bike Lane in Downtown Davis Core Area

Source: Author

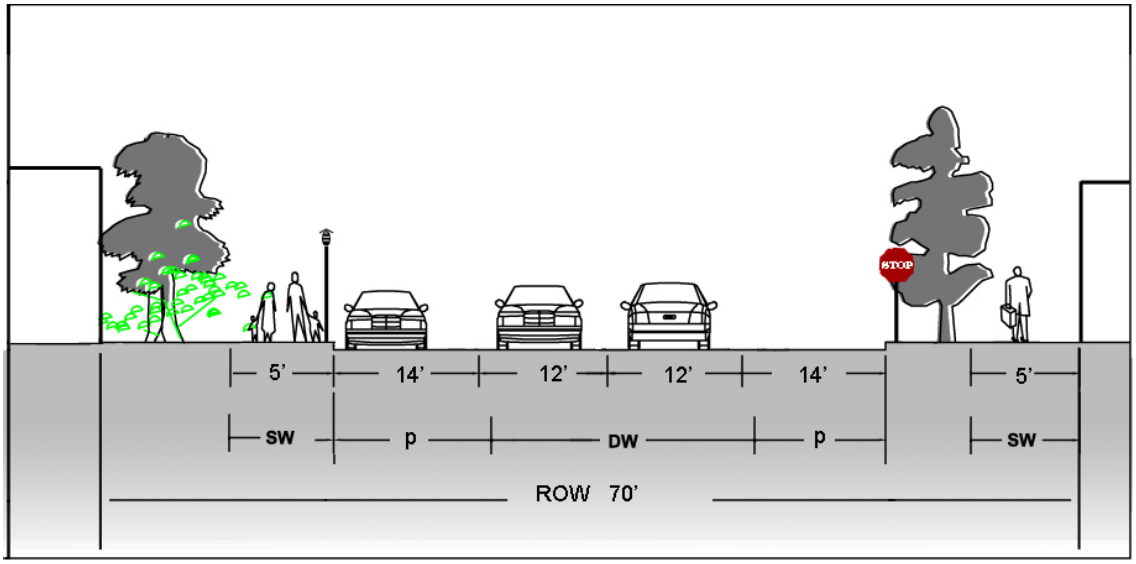


Figure 11: An Example of Street Section - E Street

Source: Author

Trees and plantings as well as street furniture such as benches, garbage cans, and lighting are placed in most commercial streets in the downtown Davis core area (see Figure 12).

Buildings: most buildings in the downtown Davis core area are one or two-story high (see Figure 13). Almost 35 percent of the buildings are been built before the year 1939, more than 50 percent of the buildings between the year of 1940 to 1980, and there has been no new construction after the year 1995 (Downtown Core Neighborhood in Davis, California (CA) Detailed Profile 2010).

Figure 12: Street Landscape and Furniture in Downtown Davis Core Area

Source: Author

Figure 13: Buildings in Downtwon Davis Core Area

Source: Author

Parking: in the downtown Davis core area, visitors can park their cars on both sides of all commercial streets except for the 5th Street which is a major arterial road (see Figure 14). There are several parking lots on E Street between 3rd and 4th Street, F Street between 3rd and 4th Street, E Street between 2nd and 3rd Street, and G Street between 2nd and 3rd Street. There are two parking structure in the downtown Davis core area. One is located in the corner of 1st and F Street . The other is located in the corner of 4th Street and the railroad. On-street parking, parking lots, and parking structure provide convenient ways for people who visit the downtown Davis core area with personal cars.

Figure 14: On-Street Parkings in Downtown Davis Core Area

Source: Author

Chapter 4: Methods

Observation and survey methods are introduced in this chapter, and the chapter contains two sections. In the section titled "Observations from the Commercial Streets and Findings", the process of the observation and the analysis of the data are presented: where and when does the observation take place, how to observe and measure the dependent and independent variables, how to analyze the collected data, and the findings. In the section of "Survey of users of Commercial Streets and Findings", similar process mentioned in the section of "Observations from the Commercial Streets and Findings" would be utilized to collect and analyze the data.

a) Observations from the Commercial Streets and Findings

Why the vibrancy of each block/street is different even though the block/streets are located very close to each other? There should be some elements that affect people's perception of the commercial streets and their choices of using them. The major purpose of the observation is to identify the elements that contribute to the street vibrancy in order to enhance the street vibrancy of commercial streets in the downtown core area of Davis.

Observation areas

Twelve commercial streets –A Street, University Avenue, B Street, C Street, D

Figure 15: Street/Blocks for Observation in Downtown Davis Core Area

Data Source: City of Davis GIS Library, Metropolitan Transportation Commission GIS Data. Designed by the author.

Street, E Street, F Street, G Street, Rice Ln Street, 2nd Street, 3rd Street, and 4th Street in the downtown Davis core area are chosen for this research as shown in Figure 15.

The author divided the streets/ blocks into small block segments for observation, and in total 113 block segments in the downtown core area are selected for further study. The selected block segments have different physical conditions. For example, streets/blocks with different land uses (commercial uses, plaza, park, etc), with different level of landscaping features, with different conditions of street furniture (number of benches, gar-

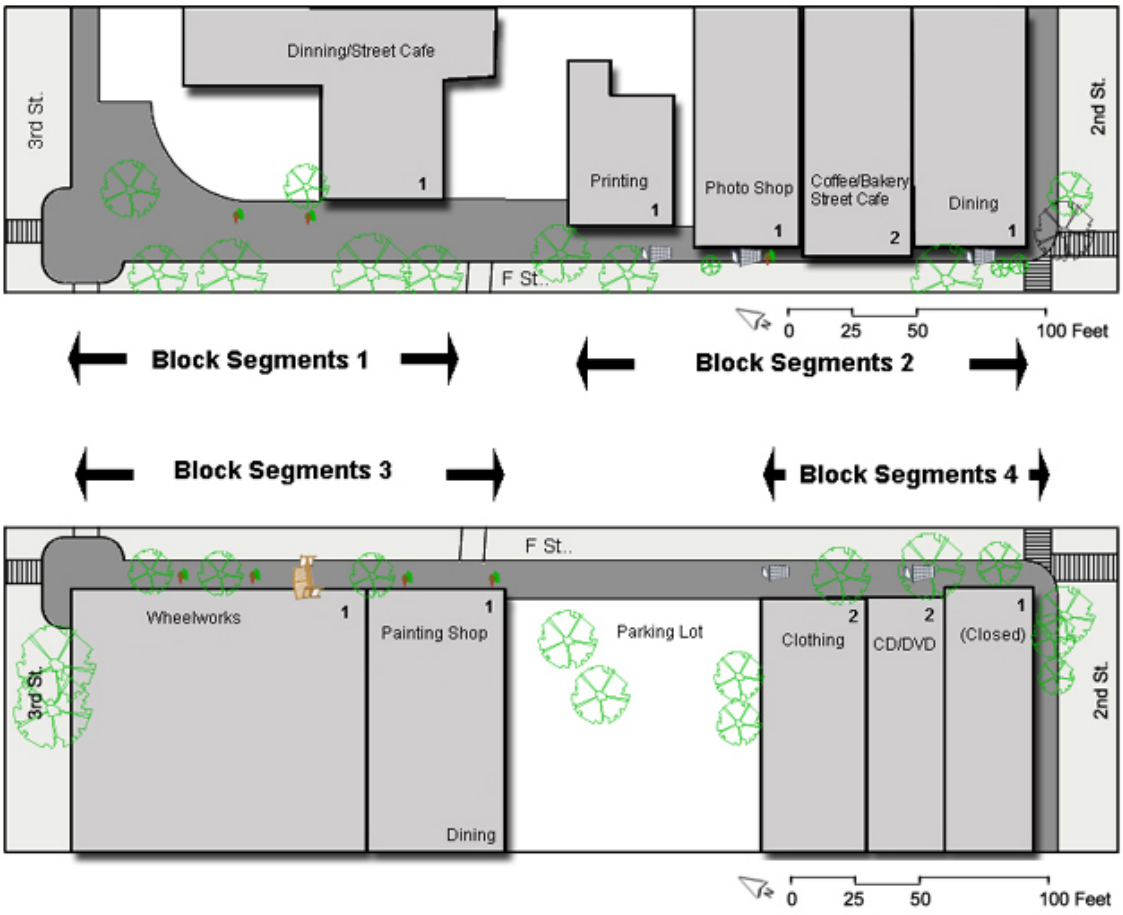


Figure 16: Examples of Black Segment Layouts for Observation – East and West Sections of F St. between 2nd and 3rd St. in Downtown Davis Core Area

Data Source: Google Earth and personal observation of the commercial streets. Designed by the author.

bage cans, bike lockers, etc.) are chosen for the observation. The author created detailed layout plan for each block-segment which includes land uses, stories of buildings, location of the landscape and street furniture, and so on (see Figure 16 for an example of block segments layout for the observation). Various street activities are marked on each block-segment layout for the research.

Observation Time and Duration

Data were collected between 12:30 pm and 13:15 pm on weekdays from January to March 2011. The author observed various activities on each black segment for 10 minutes. No observations were done when it was raining. The temperatures of the each observation day ranged from 54 to 66 ° F.

Measuring the Dependent Variable

The author observed various activities on the streets which were mainly focused on: the positions where people sit, stand, and do other activities; the duration of these activities; and the total number of people who walk through the block. Different

Table 1: Symbols, Colors, and Comments Used in Observation

Activities	Symbols	Colors	Comments
Seating	S1	●	Conversation
	S2		Eating/ drinking
	S3		Reading
	----		----
Standing	↑1	●	Window shopping
	↑2		Conversation
	↑3		Waiting
	----		----

symbols and colors are used to indicate seating and standing activities and each person is numbered as well. The total number of people involved in certain activities is computed. Specific description of each activity for seating and standing is written into comments column such as conversation, eating/drinking, reading, etc. for seating; and window shopping, conversation, waiting, etc. for standing (see Table 1).

Vibrancy Index

The "vibrancy (vitality)" refers to "the numbers of people in and around the street (pedestrian flows) across different times of the day and night" (Montgomery 1998, 96). Gehl and Mehta indicate that the number of people and the duration of their stay create the overall activities or liveliness of an environment of public place (Gehl, 1987; Mehta 2009, 40). Therefore A "Vibrancy Index" is created to measure the number of people's activities on the streets by calculating the data collected from observations.

The Vibrancy Index is computed for each block-segment by the results of observation of (1) seating activities; (2) standing activities; (3) people's duration of stay; and (4) the number of people walking through the block-segment. Studies showed that the number of people and duration of their stay are equally important (Gehl, 1987; Mehta 2009, 40). Therefore the first three measures are standardized and given equal value in determining the Vibrancy Index. Each person observed in seating activity on the block-segment accounted for one unit score. In addition, each person observed in standing activity on the block-segment accounted for one unit score. Duration of stay was recorded under four categories and a corresponding score was assigned for different categories (see Table 2). Finally, each person walking through the block-segment accounted for 0.5 unit score. Although the walking through activity may not have a direct impact on investigating the relationship between the physical environment and the vibrancy of the street, it has some contributions to making a vibrant commercial street. Therefore only 0.5 is chosen for this kind of activity. The formula for calculating the Vibrancy Index of a block-segment is

$$VI = \sum_{i=1}^{n}(SE\ i \times Di) + \sum_{i=1}^{n}(ST\ i \times Di) + P \times 0.5$$

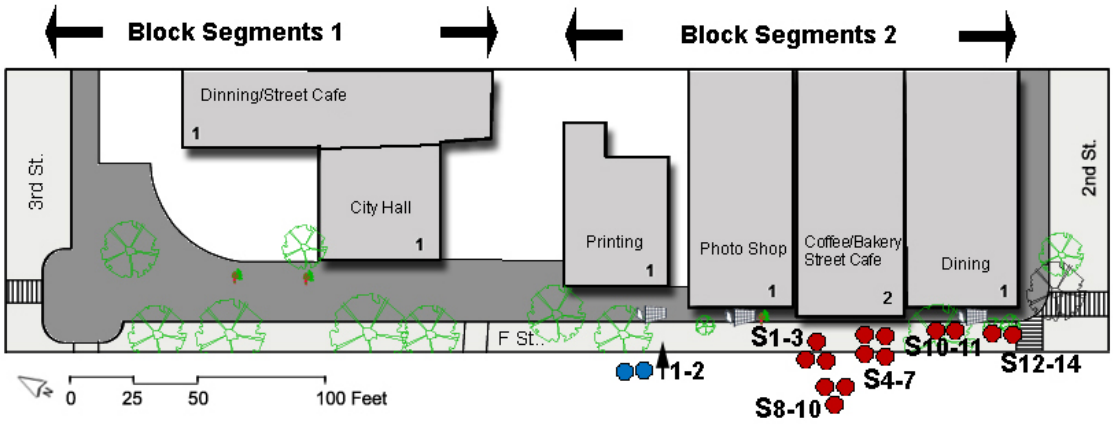
(VI indicates the Vibrancy Index, SE indicates the person involved in seating activity, ST indicates the person involved in standing activity, P indicates the number of people walking through the block-segment, and D indicates the duration of certain activities.)

Table 2: Assigned Scores for Duration of Sitting and Standing Activities

Sitting		Standing	
Duration of Stay Assigned	Score	Duration of Stay Assigned	Score
0 -1 minute	1	0-30 seconds	1
1 to - 3 minutes	2	30 seconds -1 minutes	2
3 to - 5 minutes	3	1 minutes – 90 seconds	3
5 to - 10 minutes	5	90 seconds- 2 minutes	4
		2-10 minutes	5

Note: A similar method was introduced in Mehta's research in 2009. He created "liveliness Index" for stationary, sustained and lingering activities on the street. The differences are presented as follows. a) A different category of street activities is considered in this report which includes seating and standing. b) The author differentiated scores for duration for seating and standing. c) The author counted the number of people walking through the street.

Figure 17 presents an example of the outcome of street observation conducted in block segments - F Street between 3rd Street and parking lot and F Street between parking lot and 2nd Street - on February 11, 2011. It is interesting to



Date: 2/11/2011	Time: 12:48-12:58 p.m.		Temperatures: 64 °F		
Block Segments	**Segment 1: F St. 3rd St. - Parking Lot(E)**			**Segment 2: F St. Parking Lot – 2nd St. (E)**	
Activity		**Duration (Minutes)**	**Comments**		**Duration (Minutes)**	**Comments**
Seating				S1-3	10	Eating
				S4-7	10	Eating
				S8-10	10	Eating
				S10-11	4	Eating
				S12-14	2	Eating
Standing				↑ 1-2	6	Talking
Walking(# of people walking through)	27			80		
Vibrancy Index	**13.5**			**110**		

Figure 17: An Example of Street Observation Outcome

Source: Designed by the author based on Google Earth and personal observation of the commercial streets.

note that although two block segments are next to each other, the street vibrancy (Vibrancy Index) is very different.

Measuring Independent Variables

Macro-Level: To better understand the relationship between physical features of the built environment and walking behavior, Ewing et al. (2005 & 2006) developed an operational measurement protocol that could quantify the urban design qualities related to walking behavior. The report was prepared for the Active Living Research Program of the Robert Wood Johnson Foundation. Nine urban design qualities recommended by the urban design and planning expert panel members (Victor Dover - urban designer, Geoffrey Ferrell - urban designer/code expert, Mark Francis - landscape architect, Michael Kwartler - architect/simulations expert, Rob Lane - urban designer, Anne Vernez Moudon – urban designer/planner, Tony Nelessen - urban designer, John Peponis - architect/space syntax expert, Michael Southworth - urban designer, Dan Stokols - social ecologist) were used to determine the quality of the physical features of the streets. Those nine design qualities were imageability, legibility, visual enclosure, human scale, transparency, linkage, complexity, coherence, and tidiness (Ewing et al. 2005 & 2006).

Similarly, to understand the relationship between the physical environment and the vibrancy of the commercial streets (Vibrancy Index), the author evaluated the physical environment of the commercial streets in downtown Davis core area. Several macro-level design qualities were used for determining the physical environment such as visual enclosure, human scale, transparency, and complexity as shown in Table 3.

Three values (1 for good, 2 for average, and 3 for bad) are used for quantifying each physical environment qualities.

Figure 18 shows examples of how the author evaluated physical environment qualities mentioned above for block segments in the downtown Davis core area.

Table 3: Physical Environment Qualities for Observation and their Definition

Physical Environment Qualities	Definition and Description
Visual Enclosure	"Enclosure refers to the degree to which streets and other public spaces are visually defined by buildings, walls, trees, and other elements. Spaces where the height of vertical elements is proportionally related to the width of the space between them have a room-like quality."
Human Scale	"Human scale refers to a size, texture, and articulation of physical elements that match the size and proportions of humans and, equally important, correspond to the speed at which humans walk. Building details, pavement texture, street trees, and street furniture are all physical elements contributing to human scale."
Transparency	"Transparency refers to the degree to which people can see or perceive what lies beyond the edge of a street or other public space and, more specifically, the degree to which people can see or perceive human activity beyond the edge of a street or other public space. Physical elements that influence transparency include walls, windows, doors, fences, landscaping, and openings into midblock spaces."
Complexity	"Complexity refers to the visual richness of a place. The complexity of a place depends on the variety of the physical environment, specifically the numbers and kinds of buildings, architectural diversity and ornamentation, landscape elements, street furniture, signage, and human activity."

Note: all physical environment quality definitions are from research by Ewing et al. in 2005.

Visual Enclosure		
Good (1)	Average (2)	Poor (3)
		
3rd St. between E and F St.	*E St. between 3rd and 2nd St.*	*C St. between 4th and 5th St.*
Human Scale		
Good (1)	Average (2)	Poor (3)
		
D St. between 3rd and 2nd St.	*2nd St. between E and D St.*	*4th St. between C and D St.*

Figure 18: Examples of Quantifying Physical Environment Qualities of Block Segments

Source: Author

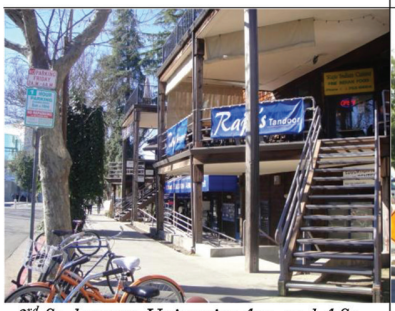
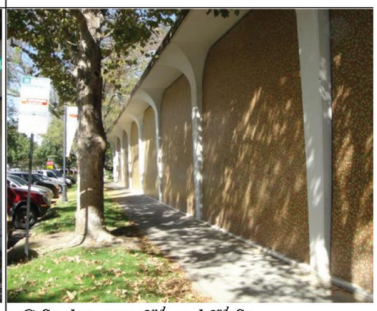
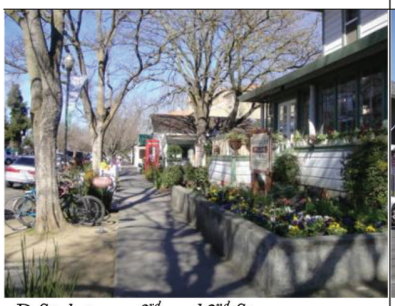
Transparency		
Good (1)	Average (2)	Poor (3)
		
3rd St. between University Ave. and A St.	*F St. between 3rd and 2nd St.*	*C St. between 2nd and 3rd St.*
Complexity		
Good (1)	Average (2)	Poor (3)
		
D St. between 3rd and 2nd St.	*D St. between 2nd and 1st St.*	*3rd St. between C and B St.*

Figure 18- Continued

Micro-Level: In addition, several micro-level physical design elements were used for evaluating relationship between physical environment and Vibrancy Index. For example, land uses that support outdoor activities on the streets such as street café and shopping stores, the condition of landscape features, the condition of street aesthetic, and the condition of street furniture were used as independent variables.

Three values (1 for good, 2 for average, and 3 for bad) are used for measuring each physical environment quality. More detailed evaluating form for each block segment is listed in Appendix B. Figure 19 and 20 show examples of how the author evaluated physical environment for block segments in the downtown Davis core area.

Name of Block Segment: **E Street between 2nd and 3rd Street (East Side)**

Evaluation Date & Time: **Feb. 23, 2011 14: 15 p. m.**

Macro level	Good	Average	Poor
Visual Enclosure	√		
Human Scale		√	
Transparency	√		
Complexity	√		

Micro level			
Street furniture (type and #)	Bench 8, Lamp 2, Bike Locker 3, Garbage Can 2, Signe 1		
The width of sidewalk	5.3		
Land uses that support out activities on the streets such as street café and shopping	Good √	Average	Poor
The condition of landscape feature	Good	Average √	Poor
The condition of street aesthetic	Good √	Average	Poor
The condition of street furniture	Good √	Average	Poor

Figure 19: An Example of Street Evaluation - E Street between 2nd and 3rd Street (East Side)

Source: Author

Name of Block Segment: **E Street between 3rd and 4th Street (East Side)**

Evaluation Date & Time: **Feb. 23, 2011 14: 25 p. m.**

Macro level	Good	Average	Poor
Visual Enclosure		√	
Human Scale		√	
Transparency		√	
Complexity		√	

Micro level			
Street furniture (type and #)	Bench 2, Lamp 2, Bike Locker 2, Garbage Can 1		
The width of sidewalk	4.8		
Land uses that support out activities on the streets such as street café and shopping	Good	Average √	Poor
The condition of landscape feature	Good	Average √	Poor
The condition of street aesthetic	Good	Average	Poor √
The condition of street furniture	Good	Average √	Poor

Figure 20: An Example of Street Evaluation - E Street between 3rd and 4th Street (East Side)

Source: Author

Findings of Street Observation

Macro Level - Physical Environment Qualities: The author analyzed each category of physical environment qualities by using Analysis of Variance (ANOVA): single factor for variable as shown in Table 4. Obtained p value for "Visual Enclosure", "Human Scale", "Transparency", and "Complexity" is 0.028, 0.083, 7.16E-11, and 2.47E-08 respectively (the critical p value is 0.05). The result indicates that there is difference between the groups in "Visual Enclosure", "Transparency", and "Complexity". However, there is no difference between groups in "Human Scale". Therefore street vibrancy (Vibrancy Index) is affected by "Visual Enclosure", "Transparency", and "Complexity" characteristics of the block segments in the downtown Davis core area.

Figure 21 shows the relationship between street Vibrancy Index and "Complexity" variable. There are four categories of Vi-

Table 4: Summary of ANOVA: Single Factor Test for Four Physical Environment Qualities

Category	Groups	Counts	Sum	Average	P-Value
Visual Enclosure	Good & Average	46	1148.5	25.0	**0.028**
	Poor	67	1026.5	15.3	
Human Scale	Good & Average	93	1952.5	21.0	0.083
	Poor	20	222.5	11.1	
Transparency	Good	12	609	50.8	**7.16E-11**
	Average	38	1005	26.4	
	Poor	63	561	8.9	
Complexity	Good	6	281	46.8	**2.47E-08**
	Average	44	1323	30.1	
	Poor	63	571	9.1	

Note: the critical p value is 0.05, and the data is form street observation by the author.

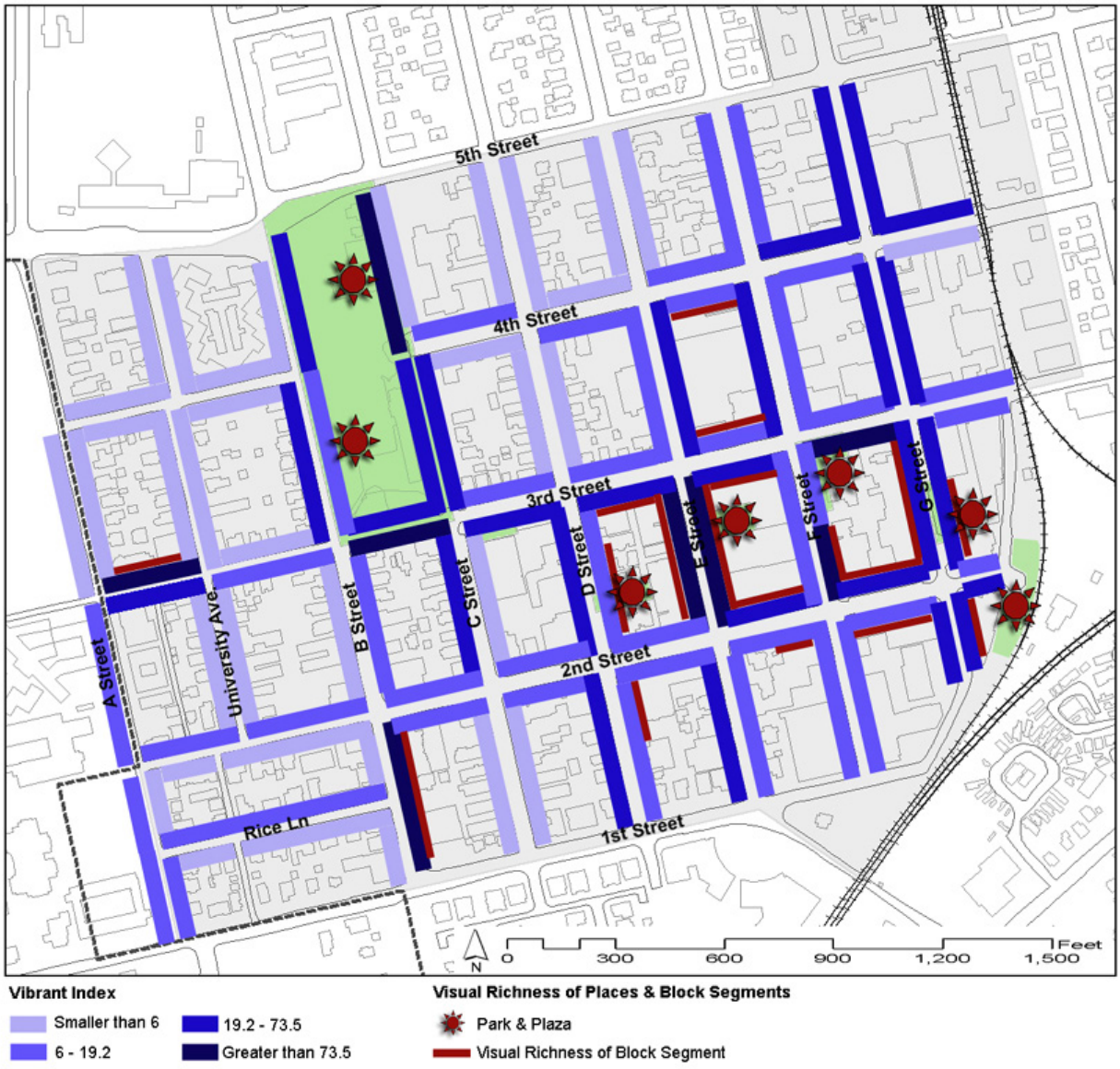


Figure 21: Distribution of Street Vibrancy Index and "Complexity" of Block Segments

Data Source: City of Davis GIS Library, Metropolitan Transportation Commission GIS Data, street observation by the author. Designed by the author.

brancy Index marked by blue color. Most block segments with high value of Vibrancy Index are the places with visual richness or near visual richness. This result is also consistent with the outcome of ANOVA analysis mentioned previously.

Micro level: Several micro-level physical design elements were used for evaluating relationship between physical environment and Vibrancy Index. Those physical design elements are land uses that support outdoor activities, the condition of landscape feature, the condition of street aesthetic, and the condition of street furniture.

Land Use that Support Outdoor Activities on the Block Segments

Based on different commercial land uses that support outdoor activities on the streets, the author evaluated all block segments, and categorized them into three different groups – "Highly Support", "Support", and "Not Support". If there are more than or equal to three stores that support outdoor activities such as street café, restaurant, and shopping store in the block segment, then this one belongs to "Highly Support" group. If there are less than two general commercial stores such as office and medical service in the block segment, then this one is categorized into

Table 5: Summary of ANOVA: Single Factor for Variable - Land Use that Support Outdoor Activities on the Block Segments

Groups	Count	Sum	Average	Variance
Highly Support	13	858	66	815.29
Support	29	729	25.14	288.89
Not Support	71	588	8.28	53.58

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	37959.25	2	18979.62	96.55	6.14919E-25	3.08
Within Groups	21622.81	110	196.571			
Total	59582.06	112				

Note: the critical p value is 0.05, and the data is form street observation by the author.

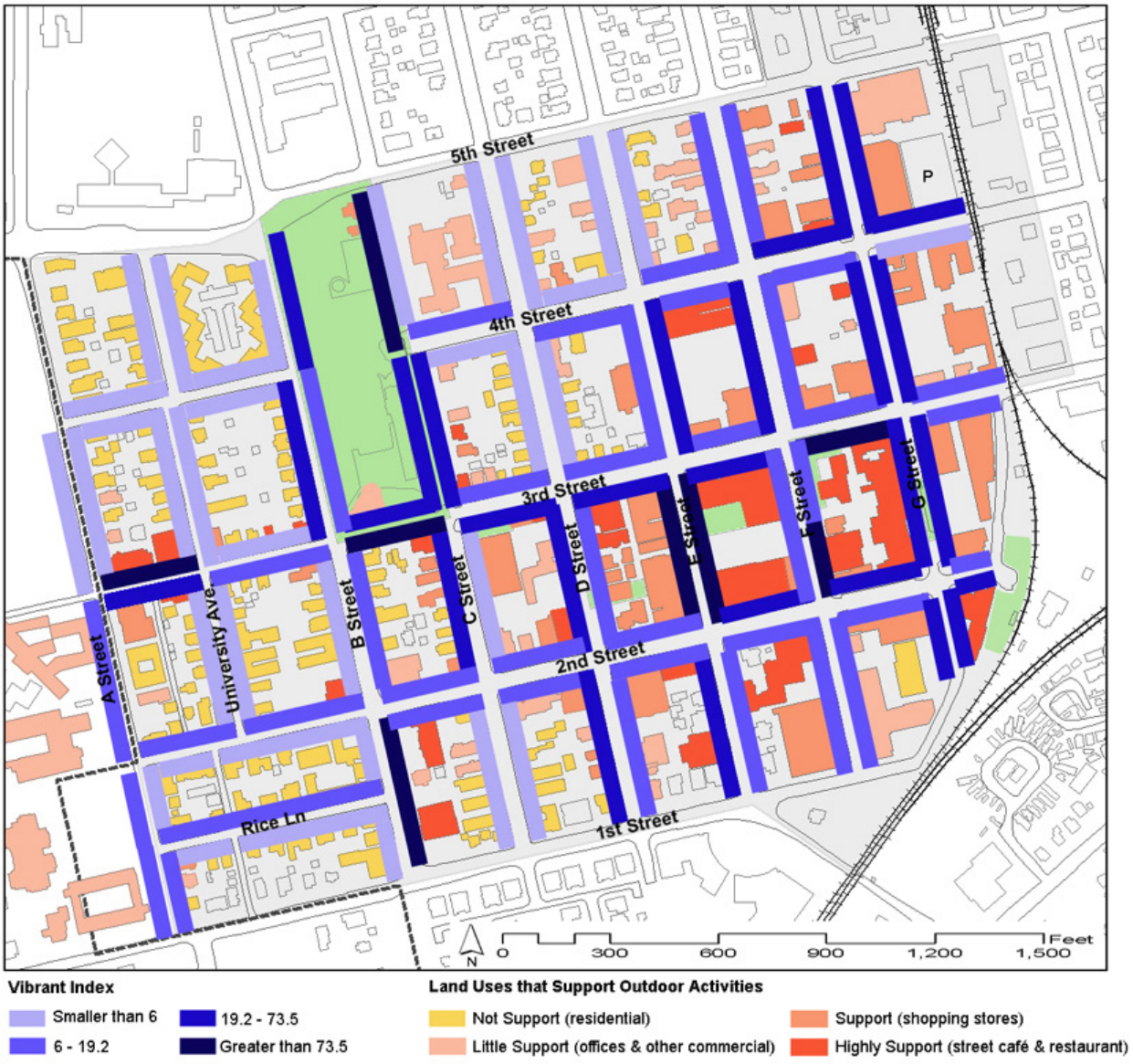


Figure 22: Distribution of Street Vibrancy Index and the Land Uses that Support Outdoor Activities on the Block Segments

Data Source: City of Davis GIS Library, Metropolitan Transportation Commission GIS Data, street observation by the author. Designed by the author.

"Not Support" group. Rest of block segments belong to "Support" group.

Then, the author analyzed the data mentioned above by using Analysis of Variance (ANOVA): single factor for variable as shown in Table 5. Obtained p value (6.14919E-25) is smaller than the critical p value of 0.05, so it indicates that there is difference between the groups. Therefore street vibrancy (Vibrancy Index) is affected by the number of land uses that support outdoor activities in block segments.

Figure 22 shows the relationship between Vibrancy Index and the land uses that support outdoor activities on the block segment. There are four categories of Vibrancy Index marked by blue color, and four categories of land uses marked by orange color. It is clearly shown that where the block segment with highly concentrated land uses has high Vibrancy Index. On the contrary, the block segment with less number of land uses has low Vibrancy Index.

The Condition of Landscape Features on the Block Segments

The author evaluated all block segments according to the condition of landscape features such as street trees, grasses, bushes, and parks. Three values (1 for good, 2

Table 6: Summary of ANOVA: Single Factor for Variable – The Condition of Landscape Feature on the Block Segments

Groups	Count	Sum	Average	Variance
Good	16	290	18.125	512.5833
Average	82	1613	19.67073	523.4581
Poor	15	272	18.13333	674.2667

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	53.46886	2	26.73443	0.049401	0.95182	3.078819
Within Groups	59528.59	110	541.169			
Total	59582.06	112				

Note: the critical p value is 0.05, and the data is form street observation by the author.

Figure 23: Distribution of Street Vibrancy Index and the Condition of Landscape Feature on the Block Segments

Data Source: City of Davis GIS Library, Metropolitan Transportation Commission GIS Data, street observation by the author. Designed by the author.

for average, and 3 for poor) are used for categorizing the condition of landscape features. Then, the author analyzed the data by using Analysis of Variance (ANOVA): single factor for variable as shown in Table 6. The finding indicates that there is no difference between the groups because obtained p value (0.95182) is greater than the critical p value of 0.05. Therefore street vibrancy (Vibrancy Index) is not affected by the condition of landscape features in downtown Davis core area.

Figure 23 shows the result of the relationship between Vibrancy Index and the condition of landscape features on the block segments. As shown in the figure, the block segment with high Vibrancy Index does not have the "good" condition of landscape feature. On the other hand, some block segments with low Vibrancy Index have the "good" condition of landscape feature. Therefore there is no clear relationship between the condition of landscape features and street vibrancy in the research area.

The Condition of Street Aesthetic & Street Furniture on Block Segments

Similarly, the author analyzed the relationship between street vibrancy (Vibrancy Index) and the condition of street aesthetic as well as the relationship between street vibrancy (Vibrancy Index)

Table 7: Summary of ANOVA: Single Factor for Variable – The Condition of Street Aesthetic on the Block Segments

Groups	Count	Sum	Average	Variance
Good	20	529.5	26.475	492.8546
Average	72	1362.5	18.92361	540.4765
Poor	21	283	13.47619	504.6119

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1751.756	2	875.8782	1.666023	0.19373	3.078819
Within Groups	57830.31	110	525.73			
Total	59582.06	112				

Note: the critical p value is 0.05, and the data is form street observation by the author.

Table 8: Summary of ANOVA: Single Factor for Variable – The Condition of Street Furniture on the Block Segments

Groups	Count	Sum	Average	Variance
Good	12	433.5	36.125	1030.688
Average	49	1409	28.7551	617.7304
Poor	52	332.5	6.394231	42.2582

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	16438.27	2	8219.135	20.95562	**1.95E-08**	3.078819
Within Groups	43143.79	110	392.2163			
Total	59582.06	112				

Note: the critical p value is 0.05, and the data is form street observation by the author.

and the condition of street furniture by using Analysis of Variance (ANOVA): single factor for variable as shown in Table 7 and Table 8.

Computed p values are 0.19373 and 1.95E-08 for the condition of street aesthetic and street furniture respectively. The findings indicate that there is no difference between the groups for evaluating the condition of street aesthetic, but there is difference between the groups for categorizing the condition of street furniture. Therefore street vibrancy (Vibrancy Index) is not affected by the condition of street aesthetic; On the other hand, it is affected by the condition of street furniture in the downtown Davis core area.

Figure 24 clearly shows the result of the relationship between Vibrancy Index and the condition of street furniture on block segments. It indicates that in general the block segment with more concentrated street furniture has higher Vibrancy Index.

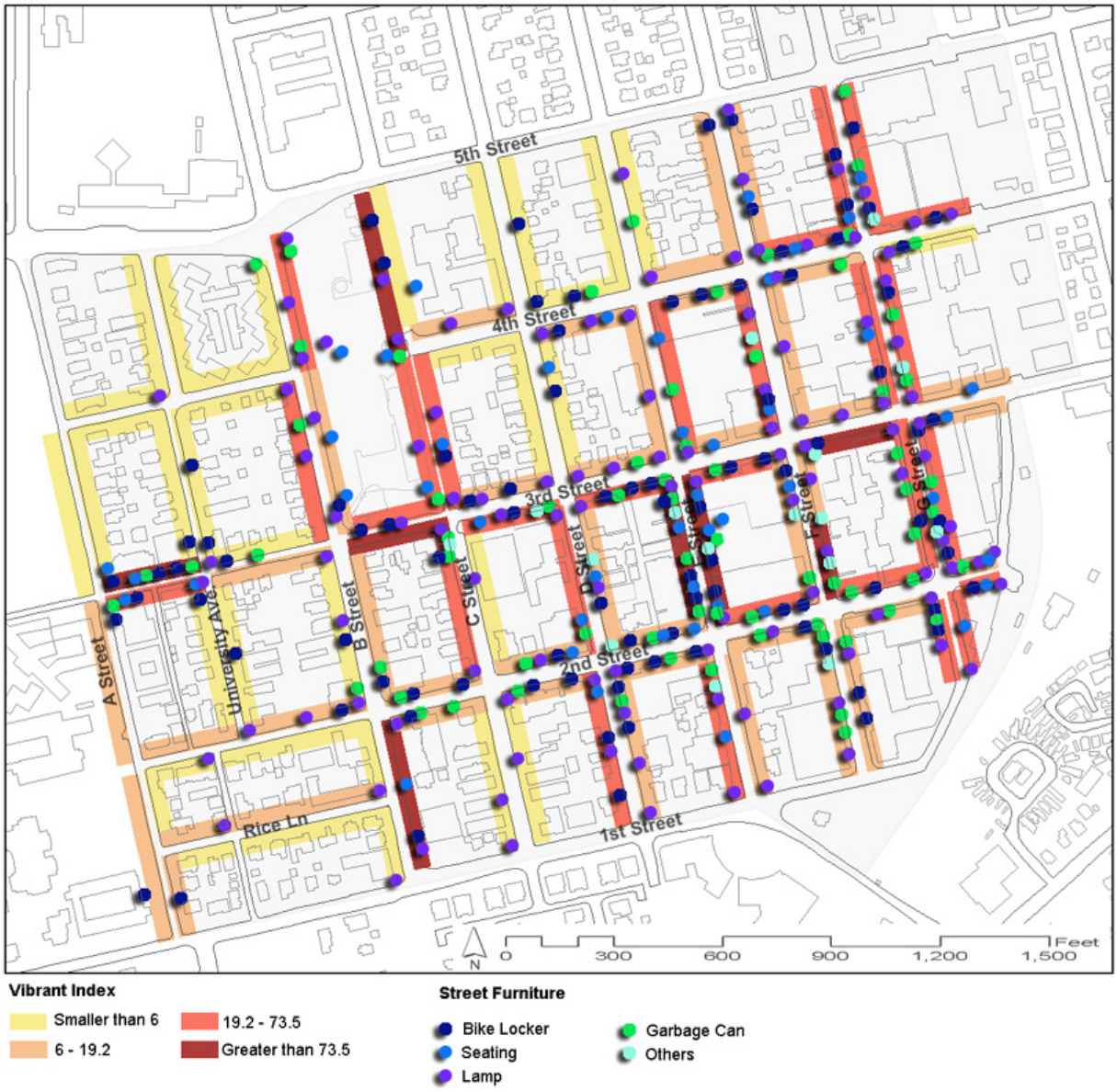


Figure 24: Distribution of Street Vibrancy Index and the Condition of Street Furniture on the Block Segments

Data Source: City of Davis GIS Library, Metropolitan Transportation Commission GIS Data, street observation by the author. Designed by the author.

b) Survey of users of Commercial Streets and Findings

The purpose of a face-to-face survey is to collect in-depth information from street users to help the author to understand the users' feelings, perceptions, and attitudes toward the current/future street environments. The target respondents of the survey are the neighborhood residents, workers and visitors who actually use the selected commercial streets on a regular basis. The survey questionnaire consists of basic demographic questions, questions about the respondents' perception of the condition of the commercial street, and their preference of urban design street improvement in the future (see the Appendix C).

Time for Conducting Survey

The author conducted the survey in downtown Davis core area from January to March in 2011.

Analysis of Survey Data

The author collected total of 36 surveys. The characteristics of the respondents are listed as follows: 56% of the respondents are male and 75% are in 18-35 age group; more than half of the respondents have lived less than 5 years in the downtown core neighborhood; and 2/3 of the respondents either live or work in the neighborhood. More detailed information about the characteristics of the respondents is shown in Table 9.

Table 9: Statistical Analysis of Survey - Characteristics of Respondents

Gender :	Male	Female			
	56%	44%			
Age Groups:	**18-35**	**36-55**	**56-75**		
	75%	22%	3%		
Time Lived in Neighborhood:	**<2 Y.**	**2 to < 5 Y.**	**5 to < 10 Y.**	**≥10 Y.**	**Can't Choose**
	17%	36%	8%	6%	33%
Living/Working Status:	**Living**	**Working**	**Living & Working**		**Visitor**
	25%	14%	28%		33%

Findings of Survey Analysis

Purpose, Means of Transportation, and Motivation for Visiting the Downtown Core Area: Around 40% of the respondents visited the downtown core area for dining, and the proportion of using green transportation (which includes walking, bicycling, and public transportation) is 32 % which is smaller than that of using cars. Most respondents came to the area due to the comfortable street environment and the convenience of the location and accessibility, etc. However relatively less proportion of the respondents showed up in the area for shopping, and no respondent used the public transportation as shown in Table 10.

About Survey Question: "The Most Important Things about This Block/Street that You would Like to Preserve/ Change or Add": As shown in Table 11, the top five choices for important things worth preserving are: diversity of uses, landscape features, pedestrian-friendly street, stores

Table 10: Statistical Analysis of Survey - Purpose, Means of Transportation, and Motivation of Visiting Downtown Core Area

Purpose :	**Shopping**	**Dining**	**Entertainment /Social Contact**		**Leisure/Exercise**	**Other**
	10%	**40%**	23%		23%	4%
Means of Trans.:	**Walk**	**Bicycle**	**Public Trans.**	**Car**	**Mixed (Car & Bicycle)**	
	16%	16%	0%	**66%**	3%	

Motivation for Visiting the Street/Block:	
Stores in this area offer the best deal or **service**	16%
Feel comfortable and enjoy being here due to the **street environment**	**40%**
It is **interesting** to see the different **designs** on the street including buildings, street furniture, landscape, etc.	2%
It is **convenient** for me to be here because of its location, accessibility, etc.	35%
It provides a lot of opportunities to make new friends and it makes **social interactions** easier.	5%
Cannot choose/Decline to state	2%

Table 11: Top Five Answers to "The 3 Most Important Things about This Block/Street You Would Like to Preserve?"

Answer #	Description	%
1	Diversity of uses (such as shopping stores, theaters, restaurants)	15%
6	Landscape features: Trees, flowers, etc.	14%
10	Pedestrian-friendly street with wide sidewalks, seating, shade & shelter	14%
3	Stores that support street activities/people interactions	9%
12	Parking lots near the stores	9%

that support street activities/people interactions, and parking lots near the stores as shown . On the other hand, the top five choices for things to change or add are: impact of traffic, architectural quality and building features, parking lots near the stores, landscape features, and maintenance of the street and buildings (see Table 12). Two items selected for both preserving and changing or adding are landscape features and parking lots near the stores, which means the opinions of respondents on these issues are different.

Table 12: Top Five Answers to "The 3 Most Important Things about This Block/Street You Would Like to Change or Add?"

Answer #	Description	%
8	Impact of traffic: speed of the car, noise, air pollution, etc.	16%
4	Architectural quality and building features	11%
12	Parking lots near the stores	10%
6	Landscape features: Trees, flowers, etc.	9%
13	Maintenance of the street and buildings	9%

Figure 25 indicates the different rankings for the answers to "what are three most important things you would like to preserve/ change or add in this block/street?"

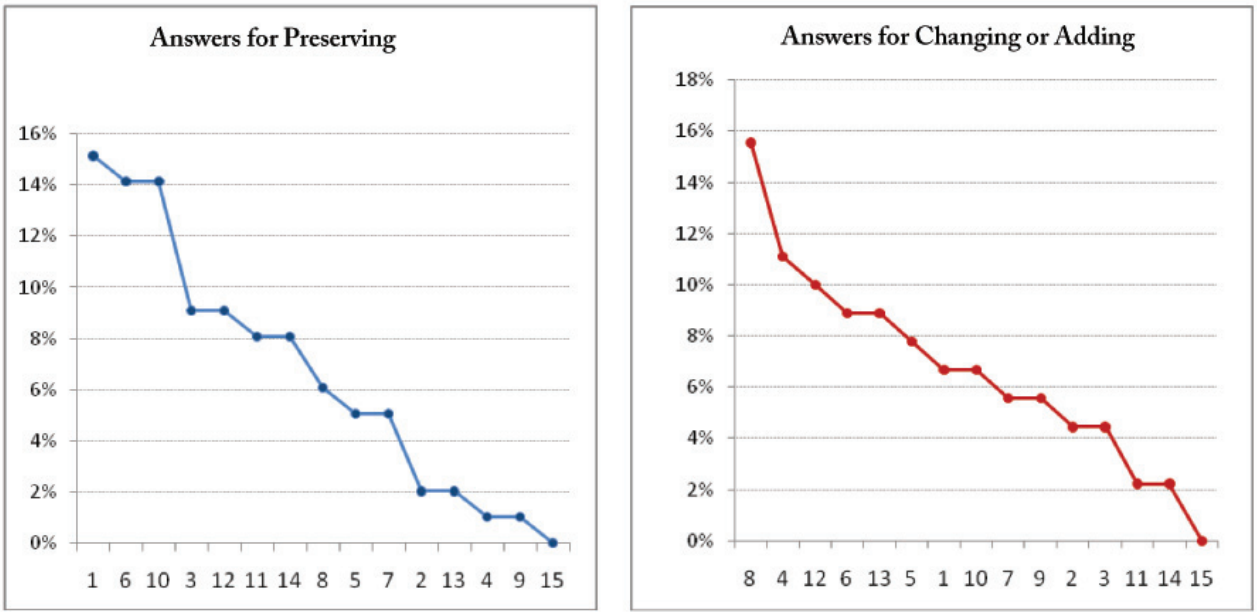


Figure 25: Rankings of Answers to "What are the 3 Most Important Things You would Like to Preserve / Change or Add in This Block/Street"

Note: answer choices for questions about "The 3 Most Important Things about This Block/Street You Would Like to Preserve or Change/Add?" are
1. Diversity of uses (such as shopping stores, theaters, restaurants)
2. The upkeep of the stores
3. Stores that support street activities/people interactions
4. Architectural quality and building features
5. Visual interest: displays, shop-windows, store signs, etc.
6. Landscape features: Trees, flowers, etc.
7. Street furniture: bench, garbage can, street light, public art, etc.
8. Impact of traffic speed of the car, noise, air pollution, etc
9. Proximity to public transit and accessible from many directions
10. Pedestrian-friendly street with wide sidewalks, seating, shade & shelter
11. Bicycle-friendly block/street: bike lanes and bike stands
12. Parking lots near the stores
13. Maintenance of the street and buildings
14. Safety on the block/street
15. Others:
20= Can't choose/Decline to state

Open-Ended Questions: Several respondents mentioned some suggestions for improving the block/street in the downtown core area in Davis. Those suggestions are categorized as shown in Table 13.

Table 13: Suggestions for Improving the Block/Street in Downtown Core Area

Uses:	
	More relaxing facility; more food/restaurant
Building:	
	More display windows in stores
Street Design:	
	wider pedestrian friendly sidewalks
Street Furniture & Landscape:	
	More seating place; more setting in the park; more landscape
Street art & Outdoor Activities:	
	More street arts; aesthetic pleasing; outdoor entertainment
Maintenance & Management & Service:	
	Pave road; improve road condition; keep the street clean; less cops
Other:	
	More parking lot; parking flexibility; more music

Chapter 5: Recommendations for Improving Commercial Streets Vibrancy in the Downtown Davis Core Area

This chapter provides several recommendations for improving the vibrancy of selected commercial streets in the downtown Davis core area. Improvement recommendations are provided under three sections which are - land uses, urban physical design, and others.

a) Land Uses

Observation results indicate that land uses that support outdoor activities such as street cafés, restaurants, and shopping stores affect street vibrancy (Vibrancy Index). Therefore urban designers and planners need to appropriately incorporate these uses into less vibrant streets or areas to improve street vibrancy in the downtown Davis core area.

b) Urban Physical Design

Survey question 16 is designed for collecting respondents' preference for urban design elements which could be used in the future improvements. The author analyzed the answers and listed top choices for the urban design elements such as street benches, plantings, lamps, garbage cans, street cafés, street arts, interesting designs, and activities.

Figure 26 shows top choices along with corresponding percentage of each choice. Those choices are what respondents would like to see in the future. Urban designers and planners could consider applying those preferences for future improvements on the commercial streets in the downtown Davis core area.

The author used several urban physical design elements from top choices of survey answers to illustrate possible improvements for E Street and C Street as shown in Figure 27 and Figure 28 respectively.

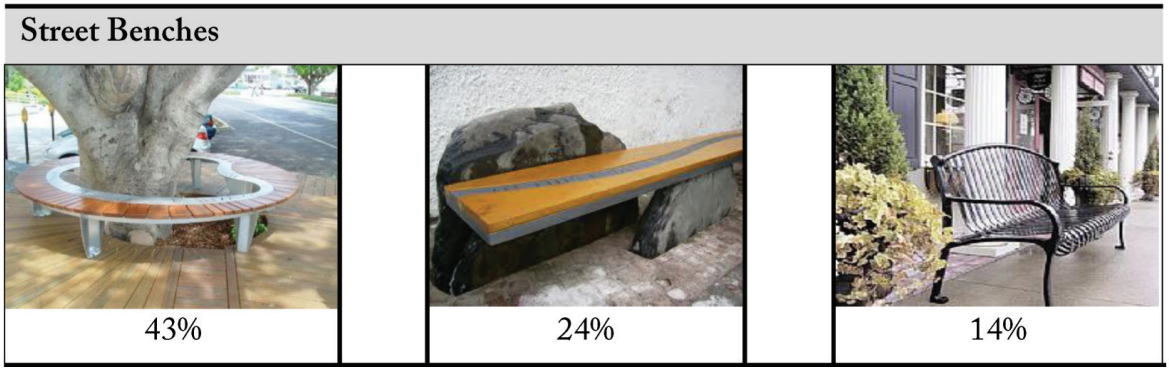


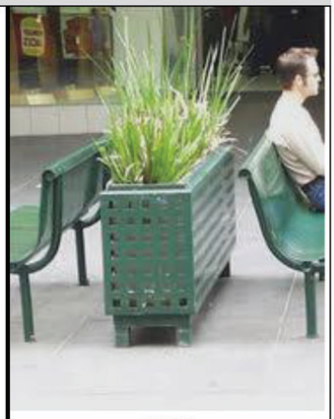
Figure 26: Respondents' Preference of Urban Physical Design Choices

Note: all images are searched from http://images.google.com/ by the relevant titles.

Street Plantings

25%

20%



18%

Street Lamp

39%

29%

24%

Street Garbage Can

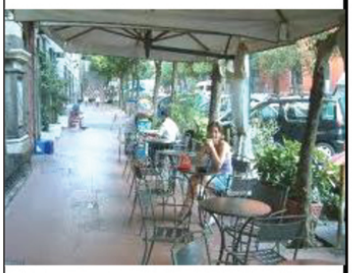
41%

38%

16%

Figure 26 - Continued

Street Cafe Type



35%

30%

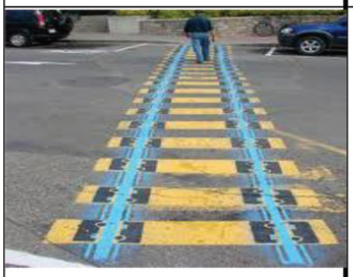
16%

Street Arts, Interesting Designs, and Activities

28%

17%

12%



9%

9%

9%

Figure 26 - Continued

Figure 27: Illustration of E Street Plaza Improvement

Source: Designed by the author.

BEFORE

AFTER

Figure 28: Illustration of Street Improvement - Coner of C & 3rd Street

Source: Designed by the author

c) Others

Survey respondents also mentioned other factors which need to be improved in the future. Those factors are “traffic impacts”, “architectural quality and building features”, “need for more parking lots near the stores”, “more landscape features”, and “better maintenance of the street and buildings”. Urban designers and planners need to take into account these factors in future development and redevelopment of the downtown Davis core area.

Chapter 6: Conclusion

This chapter presents conclusions and highlights the areas for future research. The chapter contains four sections: "Finding of the Study", "Limitation of the Study", "Policy Implication", and "Potential Future Studies".

a) Findings of the Study

Findings from observation

People's perception of the commercial street is affected by overall quality of urban planning and design elements. According to the findings by analyzing the data from street observation, elements that contribute to making a vibrant commercial street in downtown Davis could be categorized into two groups: land use characteristics, and urban physical design.

Land use characteristics: stores such as street café, restaurant, and shopping stores that support outdoor activities play a significant role in making vibrant commercial streets in the downtown Davis core area.

Urban physical design: at macro-level, three characteristics, "Visual Enclosure", "Transparency", and "Complexity" of the block segments affect commercial street vibrancy in the downtown Davis core area. In addition, commercial street vibrancy is influenced by macro-level of the urban physical design element – the condition of street furniture.

Findings from survey

Survey is designed for understanding the users' attitudes toward the current and future commercial street environments in the downtown Davis core area. The findings from survey indicate that top five choices for preserving are "diversity of uses", "landscape features, pedestrian-friendly streets", "stores that support street activities/people interactions", and "parking lots near the stores". On the other hand, "impact of traffic", "architectural quality and building features", "parking lots near the stores", "landscape features", and "maintenance of the street and buildings" are top five choices for future changes (two items selected for both preserving and changing or adding are "landscape features" and "parking lots near the stores", which means the opinions of respondents on these issues are different). In addition, the result of respondent's preference for several urban physical design elements could be used for commercial street improvements. These physical design elements include street benches, plantings, lamps, garbage cans, street cafés, street arts, interesting designs, and activities.

b) Limitations of the Study

Geographic limitation

The study area is limited to the neighborhood commercial streets in a college-oriented small city in California; therefore, the findings are most applicable to urban neighborhoods that have similar characteristics or patterns.

Time limitation

Observations of 113 block segments were conducted from 12:30 pm to 13:15 pm on weekdays from January to March 2011. Therefore it is difficult for the author to observe one block segment multiple times to construct more reliable Vibrancy Index. In addition, street activities on weekends and night might be different with that on weekdays and daytime. Because of the time and resource limitation the author is not able to observe street activities on weekends and night.

Other factors

Study indicates that ethnic group, economic class, and level of education play an important role in shaping perceptions which, in turn, affect the use of public space (Mehta, 2007). However, it was difficult to classify street users by ethnic group, economic class and level of education during the street observation. In addition, to improve the quality of the data from the observation, it would be more helpful to observe street activities on very vibrant block segments by using video cameras. Finally, subjective factors may affect the result of categorizing the physical environment quality of block segments. For example one same block segment could be categorized into different groups (1 for good, 2 for average, and 3 for poor) based on subjective determination.

c) Policy Implications

Public authorities need to provide physical street improvements taking into accounts of "Visual Enclosure", "Transparency", and "Complexity" characteristics of the street. Moreover, public authorities could encourage various businesses to support outdoor activities by providing more street furniture such as chairs and tables, and by personalizing street fronts with signs, canopies, planters, and so on.

In general, urban designers and policy makers should be sensitive to the fact that people tend to choose comfortable and pleasant street environment through macro- and micro-scale physical features. Taking into consideration physical design elements and land uses aspects together, designers and policy makers need to improve the vibrancy of the commercial streets.

d) Potential Future Studies

This research is about commercial streets vibrancy. Similar research could be conducted on other types of public spaces such as plazas and parks. In addition, smaller size of block segment could be considered for the purpose of more accurate data collection in future research. Finally, the author only considered the aspect of land uses and physical design elements that contribute to making a vibrant commercial street. The influence of meaning of the place could be considered in future study in the area.

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Appendix

A: Current Physical Condition of the Commercial Streets in Downtown Davis Core Area

Street/Block Name (directions)		Length (feet)	Sidewalk width (both sides) (feet)	Traffic lanes(both sides)	Width of right of way (feet)
A St.(E-W)	Between 1st and Rice Ln St.	203	4.3/5.2	2	65
	Between Rice Ln and 2nd St.	200			
	Between 2nd and 3rd St.	424			
	Between 3rd and 4th St.	414			
	Between 4th and 5th St.	443			
University Ave.(E-W)	Between 2nd and 3rd St.	444	3.5/3.8	2	44
	Between 3rd and 4th St.	434			
	Between 4th and 5th St.	357			
B St. (E-W)	Between 1st and Rice Ln St.	208	5.3/4.7	3	74
	Between Rice Ln and 2nd St.	209			
	Between 2nd and 3rd St.	405			
	Between 3rd and 5th St.	824			
C St. (E-W)	Between 1st and 2nd St.	389	5.6/4.7	2	70
	Between 2nd and 3rd St.	402			
	Between 3rd and 4th St.	409			
	Between 4th and 5th St.	400			
D St. (E-W)	Between 1st and 2nd St.	380	5.7/5.4	2	73
	Between 2nd and 3rd St.	403			
	Between 3rd and 4th St.	375			
	Between 4th and 5th St.	400			
E St. (E-W)	Between 1st and 2nd St.	447	4.8/5.3	2	70
	Between 2nd and 3rd St.	412			
	Between 3rd and 4th St.	416			
	Between 4th and 5th St.	400			

F St. (E-W)	Between 1st and 2nd St.	395	11.5/5.8	2	77
	Between 2nd and 3rd St.	410			
	Between 3rd and 4th St.	419			
	Between 4th and 5th St.	397			
G St. (E-W)	Between 1st and 2nd St.	341	9.2/11.9	2	72
	Between 2nd and 3rd St.	410			
	Between 3rd and 4th St.	400			
	Between 4th and 5th St.	401			
Rice Ln St. (N-S)	Between A and B St.	622	4.7/4.8	2	42
2nd St. (N-S)	Between A and University Ave	269	5.5/7.0	2	68
	Between University Ave and B St.	317			
	Between B and C St.	255			
	Between C and D St.	253			
	Between D and E St.	249			
	Between E and F St.	260			
	Between F and G St.	243			
3rd St. (N-S)	Between A and University Ave	237	5.0/6.1	2 (2 Bike lanes)	71
	Between University Ave and B St.	310			
	Between B and C St.	238			
	Between C and D St.	241			
	Between D and E St.	243			
	Between E and F St.	246			
	Between F and G St.	252			
4th St. (N-S)	Between A and University Ave	274	5.4/4.9	2	73
	Between University Ave and B St.	281			
	Between C and D St.	250			
	Between D and E St.	250			
	Between E and F St.	246			
	Between F and G St.	256			

Note: all the data is from Google Earth and the author's personal observation

B: Evaluation Form of Physical Environment for each Block-Segment

Name of Block Segment: _____

Evaluation Date & Time: _____

Macro level	Good	Average	Poor
Visual Enclosure			
Human Scale			
Transparency			
Linkage			
Complexity			

Micro level			
Street furniture (type and #)			
The width of sidewalk			
Land uses that support out activities on the streets such as street café and shopping	**Good**	**Average**	**Poor**
The condition of landscape feature	**Good**	**Average**	**Poor**
The condition of street aesthetic	**Good**	**Average**	**Poor**
The condition of street furniture	**Good**	**Average**	**Poor**

C: The Survey Questionnaire

Date: _____ Time: _____ Street Name: _____

Survey Questions:

1. **Do you live/work in this neighborhood?**
   1= I Live here
   2= I work here
   3= I live and work in this area
   4= I am a visitor (I don't live nor work in this area)
   7= Cannot choose/Decline to state
2. **If you live/work in this neighborhood, how long have you lived/worked here?**
   1= Less than 2 years
   2= 3 to 5 years
   3= 6 to 10 years
   4= More than 10 years
   7= Cannot choose/Decline to state
3. **What is your gender?**
   1= Male
   2= Female
4. **What is your age?**
   1= 18-35 years
   2= 36-55 years
   3= 56-75 years
   4= >75 years
   7= Cannot choose/Decline to state
5. **For what purposes do you visit this block/street today?**
   1= Shopping
   2= Eat/drink
   3= Entertainment and social contact
   4= Leisure and exercise (relaxing, walking, jogging, etc.)
   5= Others_____
   7= Cannot choose/Decline to state
6. **Why did you choose this block/street for the purposes mentioned in question 5?**
   1= Stores in this area offer the best deal or service.
   2= I feel comfortable and enjoy being here due to the street environment.
   3= It is interesting to see the different designs on the street including buildings, street furniture, landscape, etc.
   4= It is convenient for me to be here because of its location, accessibility, etc.
   5= It provides a lot of opportunities to make new friends and it makes social interactions easier.
   6= Others_____
   7= Cannot choose/Decline to state

7. What kind of transportation did you use for this trip to the street?

1= Walk
2= Bicycle
3= Public transportation
4= Car
5= Others_____
7= Cannot choose/Decline to state

8. How long have you spent on this trip?

1= < 15 minutes
2= 15-30 minutes
3= 30-60 minutes
4= > 60 minutes
7= Cannot choose/Decline to state

9. How long are you planning to stay in this block/street today (or usually)?

1= < 1 hour
2= 1-2 hours
3= 3-5 hours
4= > 5 hours
7= Cannot choose/Decline to state

10. How often do you visit this block/street?

1= every day or more often
2= 1-2 times per week
3= 1-2 times per month
4= Rarely
7= Cannot choose/Decline to state

11. Do you have a favorite place (e.g. stores, spots, physical designs, etc.) on this block/street?

1= Yes
2= No
7= Cannot choose/Decline to state

If <u>YES</u> list them and please explain the reason that makes them your favorite?

12. What are the 3 most important things about this block/street you would want to preserve?

_____1. Diversity of uses (such as shopping stores, theaters, restaurants)
_____2. The upkeep of the stores
_____3. Stores that support street activities/people interactions
_____4. Architectural quality and building features
_____5. Visual interest: displays, shop-windows, store signs, etc.
_____6. Landscape features: Trees, flowers, etc.
_____7. Street furniture: bench, garbage can, street light, public art, etc.
_____8. Impact of traffic: speed of the car, noise, air pollution, etc.
_____9. Proximity to public transit and accessible from many directions
_____10. Pedestrian-friendly street with wide sidewalks, seating, shade & shelter
_____11. Bicycle-friendly block/street: bike lanes and bike stands
_____12. Parking lots near the stores
_____13. Maintenance of the street and buildings
_____14. Safety on the block/street
_____15. Others: _____

20= Cannot choose/Decline to state

13. What are the 3 most important things you would like to change or add on this block/street?

_____1. Diversity of uses (such as shopping stores, theaters, restaurants)
_____2. The upkeep of the stores
_____3. Stores that support street activities/people interactions
_____4. Architectural quality and building features
_____5. Visual interest: displays, shop-windows, store signs, etc.
_____6. Landscape features: Trees, flowers, etc.
_____7. Street furniture: bench, garbage can, street light, public art, etc.
_____8. Impact of traffic: speed of the car, noise, air pollution, etc.
_____9. Proximity to public transit and accessible from many directions
_____10. Pedestrian-friendly street with wide sidewalks, seating, shade & shelter
_____11. Bicycle-friendly block/street: bike lanes and bike stands
_____12. Parking lots near the stores
_____13. Maintenance of the street and buildings
_____14. Safety on the block/street
_____15. Others: _____

20= Cannot choose/Decline to state

14. What is your feeling about the overall experience in this block/street?

1= Very satisfied (I'd like to spend more time here and revisit here in the future.)
2= Satisfied (I may like to visit this block/street again in the future.)
3= Neither satisfied nor dissatisfied (I feel no differences in here compared to other block/streets that I've visited.)
4= Dissatisfied
5= Very dissatisfied
7= Cannot choose/Decline to state

15. Please provide any suggestions for improving this block/street in the future.

_____

_____

_____

_____

_____

16. Please select one to two following design concepts which you would like to see, use, and participate on the street. (Note: all images are searched from http://images.google.com/ by the relevant titles.)

Street benches:






Street trees and flowers:






Street lamp:



Street garbage can:



Street cafe type




Street arts, interesting designs, and activities (multiple selections)

Thank you for your cooperation in completing this survey!

D: Vibrancy Index of Block Segments – Macro Level

#	Block Segment	Vibrancy Index	Visual Enclosure	Human Scale	Transparency	Complexity
1	A St. 1_Rice In(E)	10.0	2	2	3	3
2	A St. 1_Rice In(W)	6.0	2	2	3	3
3	A St. 2_3rd St.(E)	4.5	2	2	2	3
4	A St. 2_3rd St.(W)	14.5	2	2	3	3
5	A St. 3_4th St. (E)	1.0	3	3	3	3
6	A St. 3_4th St. (W)	1.5	3	3	3	3
7	A St. Rice In_2nd (E)	3.5	3	2	3	3
8	A St. Rice In_2nd (W)	13.0	3	2	3	3
9	B St. 1_2nd St.(E)	95.5	3	2	2	2
10	B St. 1_Rice St.(W)	3.0	3	2	3	3
11	B St. 2_3rd St.(E)	9.5	3	2	2	3
12	B St. 2_3rd St.(W)	4.0	3	2	2	3
13	B St. 3_4 St.(E)	15.0	3	2	2	2
14	B St. 3_4 St.(W)	22.5	3	2	3	3
15	B St. 4_5th St. (E)	31.5	3	2	1	2
16	B St. 4_5th St. (W)	1.5	3	2	3	3
17	B St. Rice_2nd.(W)	0.5	3	2	3	3
18	C St. 1_2nd St. (E)	2.0	3	2	2	2
19	C St. 1_2nd St. (W)	2.0	3	2	3	2
20	C St. 2_3rd St. (E)	5.5	2	2	3	3
21	C St. 2_3rd St. (W)	21.5	2	2	2	2
22	C St. 3_4th St. (E)	30.5	3	2	3	2
23	C St. 3_4th St. (W)	27.0	3	2	2	1
24	C St. 4_5th St. (E)	1.0	3	3	3	2
25	C St. 4_5th St. (W)	94.0	3	3	1	1
26	D St. 1_2nd St.(E)	7.0	3	3	3	3
27	D St. 1_2nd St.(W)	26.5	3	3	3	3
28	D St. 2_3rd St.(E)	19.5	2	2	2	2
29	D St. 2_3rd St.(W)	12.5	2	2	3	3
30	D St. 3_4th St.(E)	5.0	3	3	3	3
31	D St. 3_4th St.(W)	2.0	3	3	3	3

32	D St. 4_5th St. (E)	2.0	3	3	3	3
33	D St. 4_5th St. (W)	4.5	3	3	3	3
34	E St. 1_2nd (E)	9.5	2	2	3	2
35	E St. 1_2nd (w)	49.0	2	2	2	2
36	E St. 2_3rd (E)	83.0	1	2	1	1
37	E St. 2_3rd (W)	81.0	1	2	1	2
38	E St. 3_4th (E)	22.0	2	2	2	2
39	E St. 3_4th (W)	11.0	2	2	2	1
40	E St. 4_5th (E)	1.5	3	3	3	3
41	E St. 4_5th (W)	2.0	3	3	3	3
42	F St. 1_2nd (E)	8.5	2	2	3	2
43	F St. 1_2nd (W)	14.0	2	2	2	2
44	F St. 3rd_Parking (E)	13.5	2	2	3	2
45	F St. 3rd_Parking (W)	15.5	2	2	2	3
46	F St. 4_3 rd St. (E)	18.0	3	2	2	3
47	F St. 4_3 rd St. (W)	22.5	3	2	2	3
48	F St. 4_5th (E)	8.0	3	2	3	3
49	F St. 4_5th (W)	6.5	3	2	3	3
50	F St. Parking_2nd (E)	110.0	2	2	1	2
51	F St. Parking_2nd (W)	15.5	2	2	2	2
52	G St. 1_2(E)	35.0	3	2	2	3
53	G St. 1_2(W)	28.0	3	2	3	2
54	G St. 2_3(E)	28.0	2	2	2	2
55	G St. 2_3(W)	29.0	2	2	1	2
56	G St. 3_4(E)	24.5	3	2	2	3
57	G St. 3_4(W)	22.0	3	2	3	3
58	G St. 4_5(E)	20.0	3	2	3	3
59	G St. 4_5(W)	49.0	3	2	2	3
60	Rice LN A _B (N)	14.0	2	2	3	3
61	Rice LN A _B (S)	1.5	2	2	3	3
62	University Ave. 3_4th St.(E)	1.5	3	2	3	3
63	University Ave. 3_4th St.(W)	2.0	3	2	3	3
64	University Ave. 2_3rd (E)	3.5	3	2	3	3
65	University Ave. 2_3rd (W)	2.0	3	2	3	3

66	University Ave. 4_5th(E)	1.5	3	1	3	3
67	University Ave. 4_5th(W)	0.5	3	1	3	3
68	2nd St. B_C St.(N)	13.0	2	2	2	3
69	2nd St. B_C St.(S)	13.5	2	2	3	3
70	2nd St. B_ University(N)	17.5	3	3	3	3
71	2nd St. B_ University(S)	4.5	3	3	3	3
72	2nd St. C_D St. (N)	15.5	2	2	2	2
73	2nd St. C_D St. (S)	6.5	2	2	2	2
74	2nd St. D_E St.(N)	14.5	2	2	2	2
75	2nd St. D_ E St.(S)	14.5	2	2	2	2
76	2nd St. E_F(N)	28.5	3	2	1	2
77	2nd St. E_F(S)	13.0	3	2	3	2
78	2nd St. F_G(N)	44.5	2	2	1	2
79	2nd St. F_G(S)	16.5	2	2	1	2
80	2nd St. G_ Rail(N)	15.0	2	2	2	1
81	2nd St. G_ Rail(S)	51.0	2	2	2	1
82	2nd St. University_ A St.(N)	11.0	2	2	3	3
83	2nd St. University_ A St.(S)	3.5	2	2	3	3
84	3rd B_C St(N)	27.0	3	2	2	2
85	3rd B_C St(S)	73.5	3	2	2	2
86	3rd St D_E St.(N)	11.0	2	2	3	2
87	3rd St D_E St.(S)	30.0	2	2	1	2
88	3rd St. A_ University(N)	99.5	2	2	2	2
89	3rd St. A_ University(S)	34.5	2	2	2	2
90	3rd St. B_ University(N)	55.0	3	2	3	2
91	3rd St. B_ University(S)	14.5	3	2	3	2
92	3rd St. C_D St. (N)	9.0	3	2	2	2
93	3rd St. C_D St. (S)	21.0	3	2	3	2
94	3rd St. E_F St. (N)	8.5	2	2	2	2
95	3rd St. E_F St. (S)	46.0	2	2	1	2
96	3rd St. F_G St. (N)	12.0	2	2	2	3
97	3rd St. F_G St. (S)	76.0	2	2	2	2
98	3rd St. G_ Rail(N)	10.0	3	2	2	3
99	3rd St. G_ Rail(S)	11.0	3	2	3	3

100	4 St. A_ University(N)	0.0	3	2	3	3
101	4 St. A_ University(S)	1.5	3	2	3	3
102	4 St. University_ B(N)	1.0	3	2	3	3
103	4 St. University_ B(S)	0.0	3	2	3	3
104	4nd St. G_ Rail(N)	20.0	3	2	3	3
105	4nd St. G_ Rail(S)	5.0	3	2	3	3
106	4th St. C_D(N)	11.0	2	3	3	3
107	4th St. C_D(S)	2.0	2	3	3	3
108	4th St. D_E(N)	3.5	3	3	3	3
109	4th St. D_E(S)	6.5	3	3	3	3
110	4th St. E_F (N)	6.5	3	2	3	3
111	4th St. E_F (S)	15.0	3	2	1	2
112	4th St. F_G (N)	22.5	3	3	2	2
113	4th St. F_G (S)	7.0	3	3	3	3

E: Vibrancy Index of Block Segments – Micro Level

#	Block Segment	Vibrancy Index	Land Uses Support Out Activities	Landscape Feature Condition	Aesthetic Condition	Street Furniture Condition
1	A St. 1_Rice In(E)	10.0	3	2	3	3
2	A St. 1_Rice In(W)	6.0	3	1	1	3
3	A St. 2_3rd St.(E)	4.5	2	2	2	3
4	A St. 2_3rd St.(W)	14.5	2	2	2	2
5	A St. 3_4th St. (E)	1.0	3	2	2	3
6	A St. 3_4th St. (W)	1.5	3	2	2	3
7	A St. Rice In_2nd (E)	3.5	3	2	3	3
8	A St. Rice In_2nd (W)	13.0	3	1	2	3
9	B St. 1_2nd St.(E)	95.5	1	2	3	2
10	B St. 1_Rice St.(W)	3.0	3	1	2	3
11	B St. 2_3rd St.(E)	9.5	3	1	2	3
12	B St. 2_3rd St.(W)	4.0	2	1	2	2
13	B St. 3_4 St.(E)	15.0	2	1	1	2
14	B St. 3_4 St.(W)	22.5	2	1	3	2
15	B St. 4_5th St. (E)	31.5	2	1	1	2
16	B St. 4_5th St. (W)	1.5	3	1	2	3
17	B St. Rice_2nd.(W)	0.5	3	2	2	3
18	C St. 1_2nd St. (E)	2.0	3	3	3	3
19	C St. 1_2nd St. (W)	2.0	3	2	3	3
20	C St. 2_3rd St. (E)	5.5	3	3	3	3
21	C St. 2_3rd St. (W)	21.5	2	2	2	3
22	C St. 3_4th St. (E)	30.5	1	1	2	3
23	C St. 3_4th St. (W)	27.0	2	2	2	2
24	C St. 4_5th St. (E)	1.0	3	2	2	3
25	C St. 4_5th St. (W)	94.0	2	1	2	2
26	D St. 1_2nd St.(E)	7.0	3	3	2	2
27	D St. 1_2nd St.(W)	26.5	3	2	2	2
28	D St. 2_3rd St.(E)	19.5	2	2	2	1
29	D St. 2_3rd St.(W)	12.5	3	2	2	3
30	D St. 3_4th St.(E)	5.0	3	2	3	3

31	D St. 3_4th St.(W)	2.0	3	2	2	3
32	D St. 4_5th St. (E)	2.0	3	2	2	3
33	D St. 4_5th St. (W)	4.5	3	2	2	3
34	E St. 1_2nd (E)	9.5	3	2	2	3
35	E St. 1_2nd (w)	49.0	2	2	2	2
36	E St. 2_3rd (E)	83.0	1	2	1	1
37	E St. 2_3rd (W)	81.0	1	2	1	1
38	E St. 3_4th (E)	22.0	2	2	3	3
39	E St. 3_4th (W)	11.0	3	2	2	3
40	E St. 4_5th (E)	1.5	3	1	2	3
41	E St. 4_5th (W)	2.0	3	2	3	3
42	F St. 1_2nd (E)	8.5	3	3	1	2
43	F St. 1_2nd (W)	14.0	3	3	2	2
44	F St. 3rd_Parking (E)	13.5	3	3	1	1
45	F St. 3rd_Parking (W)	15.5	3	3	1	1
46	F St. 4_3 rd St. (E)	18.0	2	2	2	2
47	F St. 4_3 rd St. (W)	22.5	2	3	2	2
48	F St. 4_5th (E)	8.0	3	1	2	2
49	F St. 4_5th (W)	6.5	3	1	2	3
50	F St. Parking_2nd (E)	110.0	1	3	2	2
51	F St. Parking_2nd (W)	15.5	2	3	2	2
52	G St. 1_2(E)	35.0	2	2	2	2
53	G St. 1_2(W)	28.0	3	2	2	2
54	G St. 2_3(E)	28.0	3	1	1	1
55	G St. 2_3(W)	29.0	3	2	1	2
56	G St. 3_4(E)	24.5	2	2	2	2
57	G St. 3_4(W)	22.0	3	2	2	2
58	G St. 4_5(E)	20.0	3	2	2	2
59	G St. 4_5(W)	49.0	1	2	2	2
60	Rice LN A _B (N)	14.0	3	2	2	3
61	Rice LN A _B (S)	1.5	3	2	2	3
62	University Ave. 3_4th St.(E)	1.5	3	2	2	3
63	University Ave. 3_4th St.(W)	2.0	3	2	2	3

64	University Ave. 2_3rd (E)	3.5	3	2	2	3
65	University Ave. 2_3rd (W)	2.0	3	2	2	3
66	University Ave. 4_5th(E)	1.5	3	2	1	3
67	University Ave. 4_5th(W)	0.5	3	2	2	3
68	2nd St. B_C St.(N)	13.0	3	3	2	2
69	2nd St. B_C St.(S)	13.5	3	2	2	2
70	2nd St. B_ University(N)	17.5	2	2	2	3
71	2nd St. B_ University(S)	4.5	3	3	3	3
72	2nd St. C_D St. (N)	15.5	3	1	2	2
73	2nd St. C_D St. (S)	6.5	3	2	2	2
74	2nd St. D_ E St.(N)	14.5	2	2	1	1
75	2nd St. D_ E St.(S)	14.5	1	2	1	1
76	2nd St. E_F(N)	28.5	2	2	1	2
77	2nd St. E_F(S)	13.0	2	3	2	2
78	2nd St. F_G(N)	44.5	1	2	1	2
79	2nd St. F_G(S)	16.5	2	3	1	2
80	2nd St. G_ Rail(N)	15.0	3	2	1	1
81	2nd St. G_ Rail(S)	51.0	2	2	2	2
82	2nd St. University_ A St.(N)	11.0	3	2	3	3
83	2nd St. University_ A St.(S)	3.5	3	2	3	3
84	3rd B_C St. (N)	27.0	2	2	2	2
85	3rd B_C St. (S)	73.5	1	2	2	2
86	3rd St D_E St.(N)	11.0	3	2	2	2
87	3rd St D_E St.(S)	30.0	2	2	2	2
88	3rd St. A_ University (N)	99.5	1	2	2	1
89	3rd St. A_ University (S)	34.5	2	2	2	1
90	3rd St. B_ University (N)	55.0	1	2	3	2
91	3rd St. B_ University (S)	14.5	3	2	3	3
92	3rd St. C_D St. (N)	9.0	3	2	2	2
93	3rd St. C_D St. (S)	21.0	2	2	2	2
94	3rd St. E_F St. (N)	8.5	3	2	2	2
95	3rd St. E_F St. (S)	46.0	1	2	1	2
96	3rd St. F_G St. (N)	12.0	3	2	2	3
97	3rd St. F_G St. (S)	76.0	1	2	2	2

98	3rd St. G _ Rail(N)	10.0	3	2	3	3
99	3rd St. G _ Rail(S)	11.0	3	3	3	3
100	4 St. A _ University(N)	0.0	3	2	3	3
101	4 St. A _ University(S)	1.5	3	2	3	3
102	4 St. University _ B(N)	1.0	3	2	2	3
103	4 St. University _ B(S)	0.0	3	2	3	3
104	4nd St. G _ Rail(N)	20.0	2	2	2	2
105	4nd St. G _ Rail(S)	5.0	3	2	2	3
106	4th St. C_D(N)	11.0	3	2	2	3
107	4th St. C_D(S)	2.0	3	2	3	3
108	4th St. D_E(N)	3.5	3	2	2	2
109	4th St. D_E(S)	6.5	3	2	2	2
110	4th St. E_F (N)	6.5	3	2	2	3
111	4th St. E_F (S)	15.0	2	2	1	1
112	4th St. F_G (N)	22.5	3	2	1	2
113	4th St. F_G (S)	7.0	3	2	2	2