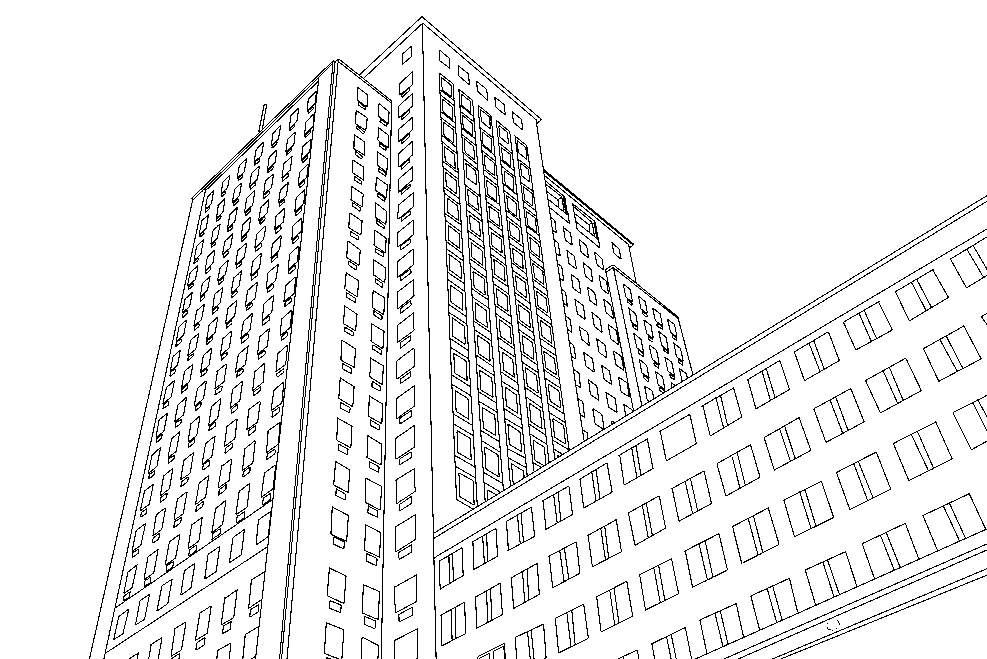
Pedestrian and Transit Oriented Design Course

# NITC Final Report



# Prepared by Shima Hamidi and Philip Stoker

# Letter of Transmittal

Dear NITC,

We greatly appreciated the opportunity to prepare, develop, and offer this course, Pedestrian and Transit Oriented Design. The course was a success, and our students travelled to six cities across the U.S. to measure and assess TOD best practices and the state of the art practice. The course was informative, challenging, and educational. We hope we speak for the students as well. The support from NITC made this course possible, and we are transmitting this report as the conclusion of this project.

This report includes background information on the course, and how we structured this course. A separate file transmittal includes all course materials, including lectures, readings, and materials that we used for this course. The hope is that this initial offering sets the foundation for future course offerings, at the University of Utah and in other universities across the nation.

In this report, we have also included each of the student authored reports on TOD in six cities: Atlanta, Denver, Los Angeles, Portland, San Diego, and Washington D.C. The students followed a basic outline for each section, however their insights are unique and their own.

Should you have any questions or clarifications, we are happy to discuss at your convenience.

Sincerely,

Shima Hamidi

Assistant Professor, University of Texas Arlington

shima.hamidi@gmail.com

Philip Stoker

Postdoctoral Research Associate, University of Arizona

Philip.a.stoker@gmail.com

# Executive Summary

Much has changed recently in how communities are designed. New urbanism has flourished, transit-oriented development has become commonplace, and smart growth has gone national. All three movements emphasize pedestrian- and transit-oriented design. The travel literature has expanded to include literally hundreds of studies showing that the built environment, as measured by D variables (density, diversity, and design) affect people’s decisions to walk and use transit. Concerns over Americans’ physical inactivity, obesity, and related chronic diseases have led to the active living movement and a rich literature demonstrating how important the built environment is as an influence on physical activity and weight status. Climate change has re-emerged as a national concern, creating another imperative for reduced automobile dependence.

We proposed a graduate level multi-disciplinary course that addressed these concerns by focusing on the nexus between research and practice. The course was co-taught by Professor Reid Ewing, Hal Johnson of the Utah Transit Authority, and two planning doctoral students, Shima Hamidi and Philip Stoker. Students in the new course were introduced to the theoretical basis and design principles of compact urban development reviewed local, national and international Transit Oriented Development’s (TOD) for the urban design qualities that make a place walkable and encourage multi-modal transportation. Most importantly, students in the course travelled to six different metropolitan areas evaluate how well TOD was being implemented. Students travelled to Atlanta, Washington D.C., Denver, San Diego, Portland, Seattle and Los Angeles. Once in the cities, students collected data relating to pedestrian activities, urban design qualities, and interview data with local TOD planners. Each case study was analyzed in the “lab” using GIS and demographic data, built environment metrics, and ridership/travel data. The metropolitan areas will be selected on the basis of available household travel data and land use databases.

The intention is to increase students’ understanding of the dynamics of TOD development by bolstering qualitative data from site visits with quantitative data from the “lab.” This research allowed us to make comparisons of TOD’s, as well as make recommendations for TODs related to public health, safety, air quality, economics, and overall livability. The capstone of the course was an oral presentation by students and a compiled report based on the TOD case studies. The results of their work are presented in this report.

# Background

The term transit-oriented development (TOD) can refer to buildings or clusters of buildings near transit that are high-density and mixed-use, with walk-accessible shopping, pedestrian amenities, lower parking supply, and physical designs that are thought to encourage households to walk, bicycle, and take transit instead of driving (e.g., Belzer & Autler, 2002).

TOD can deliver a range of benefits, from reduced household driving to improved community walkability and lowered regional greenhouse gases. The travel literature has expanded to include literally hundreds of studies showing that the built environment, as measured by D variables (density, diversity, and design) affect people’s decisions to walk and use transit (Ewing and Cervero 2010). However, it can be a challenging development model to implement. Some barriers to accomplishing quality TOD include high land costs near transit, complexity of building mixed-use projects and lack of adequate infrastructure (Cervero, 2004, Anderson & Forbes, 2010).

With demographic and lifestyle changes, the consumer demand for compact, walkable, transit-served places has never been greater. The shifts are already apparent in real estate prices, with consumer demand for pedestrian-oriented communities leading to significant price premiums (Ewing & Bartholomew, 2013). Over the past decade, TOD has gained in popularity as a planning tool to promote smart growth to address changing demands. While there have been many claims for the various beneﬁts of TOD, few studies have attempted to measure its success and to provide a how-to guide to design an effective TOD project(Renne & Wells, 2005). This course attempts to operationalize a half-century of theories about urban design principles in ways that are meaningful and useful to planning and engineering students.

The course utilized a textbook for the theory portion of the class. In 2013, the Urban Land Institute and American Planning Associate co-published a book by Professors Ewing and Bartholomew entitled Pedestrian- and Transit-Oriented Design. With 28 features described and illustrated with hundreds of photos and dozens of code examples, the book is a how-to manual for creating great places. As students visit exemplary TODs from across the United States, they referred back to the text book to guide data collection.

# Course Overview

This course introduced the theoretical basis and design principles of compact urban development and reviewed local, national and international TOD’s for the urban design qualities that make a place walkable and encourage multi-modal transportation. From this review, specific TOD locations were identified and targeted for more comprehensive on-site investigations. Students in the course were sent out to different metropolitan areas with exemplary TODs to conduct interviews, collect additional data, and make a photographic record of each project. The case study TODs were analyzed in the “lab” using GIS and demographic data, built environment metrics, and ridership/travel data. The metropolitan areas were selected in part on the basis of available household travel data and land use databases. This course provided a how-to manual for creating great places that are walkable and transit oriented. It used both qualitative and quantitative research methods to provide a mix of the subjective and objective aspects of urban design and its role in creating walkable places, a key goal of smart growth. General methodology for this research includes the following components in sequence:

**Objective 1) Principles of good Pedestrian and Transportation Oriented Design:**

This course began with a review of evidence showing that Americans value walkability. It followed with a discussion of the concepts espoused by the “founding fathers (and mothers)” of the urban design field, such giants as Gordon Cullen, Kevin Lynch, Jan Gehl, and Jane Jacobs. Then it followed with descriptions of the urban design qualities that make a place walkable. The literature provided dozens of progressive local examples from around the United States. Finally, we reviewed empirical research on travel behavior, visual preference, real estate economics, and traffic safety as relates to compact, mixed use development.

**Objective 2) Quantitative Investigation and case study selection:**

Students worked with several databases including household travel surveys and the CTOD database to identify promising TODs for case study investigation. The students used CTOD’s existing database of 4,400 transit stations to conduct original analyses of transit mode shares within station areas. Students learned and work with not only linear regression analysis but geospatial processing, to identify stations and measure characteristics of the land uses around the stations remotely.

**Objective 3) Case Study Research:** Students were paired and given budgets to travel and stay in cities that had good examples of TOD. The students travelled and gathered data around three stations in each city. The data collection was both quantitative and qualitative. Where pedestrian counts and urban design qualities were measured along randomly selected street segments. The students arranged interviews with local TOD planners, and conducted the interviews to learn about the process of TOD for their selected stations.

**Objective 4) Design and Policy Synthesis:**

Through the synthesis of collected data and analysis results, students identified good TOD principles, policies and approaches that are most promising in the design and implementation of transit-oriented development projects. The students’ proposals will be presented and analyzed for viability by faculty and NITC partners. The student’s results are summarized in the following sections.

# Methods

This course utilized a mixed-methodology to gather information on TODs. Students were trained in the methodologies prior to their site visits. As a class, we employed the following methodologies:

* **Interviews:** Students conducted interviews with professional planners in their study regions. Planners were identified based off of job titles and contacted prior to the student’s travel. The students conducted the interviews in person and utilized a semi-structured interview approach. Students took detailed notes during the interview, and following the interview wrote the notes into cohesive passages. These passages were then returned by e-mail to the interviewees in order for the interviewee to review the accuracy of the notes.
* **Urban Design Audits:** We employed an established and validated urban design instrument to quantify the characteristics of urban design adjacent to TOD stations. Students randomly selected 10 street segments within ½ mile of the selected stations to audit. Once in the field, students walked up and down the street segments recording urban design qualities. In addition, the students counted the pedestrians on each street segment as a measure of walkability. These audits provided measures of imageability, enclosure, human scale, transparency, and complexity. See Appendix A for a copy of the audit.
* **Questionnaires:** The instructors developed a questionnaire to administer at the selected TOD stations to capture the views, opinions, and preferences of passengers. The questionnaire was tested on a sample population in Salt Lake City prior to student field visits. In the field, the students worked in pairs to administer the survey to passengers waiting at the stations. All persons over the age 18 who were near the station terminal were asked to participate. The survey instrument is included in Appendix A.
* **Quantitative measurement of D variables:** Prior to field visits, students calculated D variables, i.e. Density, Design, and Diversity for ½ mile around their selected TOD stations. These measures were derived using an accepted methodology and are presented in each of city sections. Data was gathered from publically available sources such as the U.S. census as well as proprietary databases on road network density.
* **Qualitative observations:** The students were encouraged to make qualitative observations as they visited the different field sites. We encouraged students to make observations about the land use around stations, station characteristics, as well as what stores and people were within ½ mile of the selected stations. Students also took photographs to supplement their qualitative observations. These observations were used to inform each of the student chapters.

# TOD’s across the U.S.

The following sections of this report are the student written sections about their TOD site visits and the information that they gathered. The student authors are listed in each section. The organization of each section is as follows:

1. **Introduction**. This section was informed by literature searches, online searches, and first-hand experience while visiting the city. Students chose to include different facts about the city as they relate to the transit operators and systems.
2. **Station Descriptions.** For each city, student’s selected three stations that exhibited characteristics of TOD. This section details how they selected the station, as well as what they found in each station. Interview data, urban design audits, and questionnaire data is summarized in this section. For every station, a summary table is provided that provides built environmental characteristics and urban design qualities.
3. **Themes**. Student’s identified themes related to TOD in all three stations. Students were encouraged to think critically and identify lessons that may apply across all three stations, and potentially in other stations around the country.

We proceed alphabetically through the cities: Atlanta, Denver, Los Angeles, Portland, San Diego, and Washington D.C.

# Atlanta

*Ashley Cleveland and Ashley Scarff*

Atlanta, the sweet spot for peaches, is now becoming a delicious spot for Transit Oriented Development (TOD). With a new General Manager and Senior Director of TOD at the helm, the Metropolitan Atlanta Rapid Transit Authority (MARTA) is now prioritizing its TOD program as a way to generate revenues for the historically struggling agency.

MARTA’s system, which consists of buses, heavy rail, and a brand new downtown streetcar loop, was originally planned as a five-county network, but has historically served only two counties. The agency does not receive any direct funding from the state of Georgia, relying on sales tax revenues from local service agreements for operating funds—this affects MARTA’s ability to expand due to financial and geographical constraints, and makes the authority’s fiscal stability extremely vulnerable to economic swings. For example, the recent recession led to the elimination of a third of MARTA’s bus routes, an increase in wait times, a 40 percent fare increase, and a drop in ridership by 1/6. When a new General Manager stepped in in 2012, auditors told him that MARTA would be bankrupt within 4-5 years if its situation did not improve (Vock, 2014).

Luckily, MARTA’s fortunes did improve. The summer of 2014 saw the agency’s first expansion in 40 years, when Clayton County residents approved a one cent sales tax increase to join the MARTA service area (Burns, 2015). Information Technology work was brought in-house, the bus fleet was converted to natural gas, Wall Street credit rating agencies upgraded MARTA’s rating, and the new General Manager finished his first year with a $9 million surplus. As for transit service, wait times were reigned in to 10 minutes between trains (during peak hours), and while a drop in ridership was seen, it was much smaller than ridership reductions in the past (Vock, 2014).

Now that MARTA leadership has shown that they can save money, they’re looking to ways that they can make money. The agency has initiated planning for TOD on its excess land at existing heavy rail stations, which it will lease to developers, rather than sell (Vock, 2014). This will make MARTA a stakeholder in Atlanta’s real estate world, innovate the standard transportation planning culture of the region, and generate much needed revenues that will allow for further service expansion. Published renderings of development at Atlanta’s King Memorial, Edgewood-Candler Park, and Avondale stations include plans for affordable, market-rate & senior housing, commercial space, public gathering spaces, pedestrian friendly streetscapes, and more. As of March 2015, MARTA is set to meet its goal of making significant TOD progress at five transit stations throughout the city by mid-2015 (Burns, 2015).

## The Stations

In an effort to select three optimal transit stations for TOD research, all of Atlanta’s transit stops were analyzed based on the socio-demographic, transportation, and built environmental characteristics of the half mile buffer areas surrounding them. The D variables, namely density, diversity, design, and destination accessibility, played a major role in this analysis. Ultimately, Peachtree Center, Edgewood-Candler Park, and Avondale heavy rail stations were chosen for their high levels of entropy (diversified employment in the surrounding area) and varied geographic locations throughout the city (urban v. suburban). Upon consultation with MARTA’s Senior Director of TOD, it was found that two of these sites are being actively pursued for TOD, making them great candidates for our analysis.

Peachtree Center station lies at the heart of the existing heavy rail network in downtown Atlanta--even though MARTA does not control land near this subterranean station, existing zoning regulations support TOD densities and land uses. Edgewood-Candler Park is along the eastern leg of the network, halfway between the urban core and suburban edge of the city. Avondale is even farther out along the same eastern leg, reaching those living in the less dense, more residential parts of Atlanta. Unlike the other cities included in this research, evaluation techniques were applied to Atlanta’s proposed TOD sites pre-development. All three stations are profiled in more detail below, and are followed by found themes and policy recommendations that planners should consider when implementing a TOD program.

The Edgewood-Candler Park station, opened in 1979, is an at-grade heavy rail station that serves MARTA’s blue and green lines. On weekdays, both the blue and green line trains arrive every 10-20 minutes, depending on peak versus non-peak times of day, with the blue line running from 5 a.m. to about 1:20 a.m., and the green line running from 5 a.m. until 9 p.m. On weekends, the green line does not run, but the blue line runs every 20 minutes from 6:15 a.m. until about 1:20 a.m. (MARTA).

The station is located in an area that falls under MARTA’s ‘neighborhood’ station typology, defined in the Authority’s TOD Guidelines as “…located in primarily residential districts, and their principal transportation function is to help the people who live nearby get to work, school, shopping, entertainment, medical services, and other destinations accessible through the transit network” (MARTA). The station is largely surrounded by residential and commercial land uses, with approximately 67% of the land within a half mile buffer of the station dedicated to residential uses (MARTA).

The Edgewood-Candler Park station is currently being targeted for TOD, and an interview with MARTA indicated that the project may break ground in 2015 or early 2016. The north and south parking lot areas must be rezoned from their current Light Industrial (I-1) and Community Business (C-1) designations to a more TOD-conducive Mixed Residential and Commercial District (MRC-3), and MARTA has already been conducting extensive community outreach to garner support for the change. The project will be built over two phases, with reductions in the amount of MARTA-owned parking, and the addition of 445 apartments (including 89 affordable units), and 10,000 square feet of commercial space (MARTA). The project description also lists the addition of bike lanes and pedestrian-friendly streets (MARTA). The agency indicated that MARTA is hoping to receive federal transportation funding from the Atlanta Regional Commission (ARC).

An analysis of D variables revealed that the Edgewood-Candler Park area has a population density that’s about half of the national average, and a significantly low employment density—this is probably due to the fact that it is largely a residential neighborhood. Even so, the area still has a higher than average job-population balance, as well as a higher entropy value of .9350. Block sizes in the Edgewood-Candler Park area are a lot larger than those around Peachtree Center, and larger than the national average, reducing pedestrian friendliness in the area. The number of intersections around the station is roughly half of the national average, which can also be improved for better connections

The urban design evaluation of selected street segments within the half mile buffer area shows that complexity and imageability scored the highest—all design indicators scored below the national averages, with the exception of complexity, which scored slightly higher than the national value of 4.73 The surveys show that riders are currently most satisfied with the availability of parking near the station, and least satisfied with transit reliability and overcrowding. When it comes to the local built environment, riders are most satisfied with how safe they feel, and least satisfied with housing prices near the station.

The Avondale station, opened in 1979, is a suburban, at-grade heavy rail station that serves the blue line. On weekdays, trains arrive every 10-20 minutes, depending on peak versus non-peak times, between the hours of 5 a.m. and 1:10 a.m. On weekends, trains arrive every 20 minutes, between 6 a.m. and 1:10 a.m. (MARTA).

Similar to Edgewood-Candler Park, the station area also has the ‘neighborhood’ MARTA typology, and is referred to as a ‘line stop,’ meaning that most riders arrive to the station on foot (MARTA). MARTA has partnered with the City of Decatur, where the station is located, to solicit development proposals for the station’s south parking lot. The station area must be rezoned from its current Institutional designation, which does not permit the recommended FAR for a neighborhood TOD, and the project is large enough in size to trigger the requirement of a time-consuming regional impact evaluation by the Georgia Department of Transportation. MARTA indicated that they are working with the City of Decatur to finalize negotiations with the selected developer now, and expect that the project will break ground in 2015. The plan is to construct the project over three phases, which will include the replacement of MARTA-owned parking and the addition of a new bus intermodal facility. The project description also outlines the addition of approximately 530 apartments (including 116 affordable independent senior units), 74 condominiums, 25,000 square feet of commercial space, and a central plaza (MARTA). MARTA plans to apply to the ARC for $4 million in federal transportation funds for the project.

As expected, the D variable analysis showed that, as distance from the downtown increased, there was a correlating decrease in population density. However, there was greater employment density in Avondale than Edgewood-Candler Park. The job-population balance and entropy values remained very high and were both above the national averages. The average block size was slightly smaller, and the number of intersections per square mile slightly greater, than those in Edgewood-Candler Park. However, the two suburban station areas were about half as walkable as Peachtree Center, based on these variables

The urban design evaluation of street segments resulted in the highest score for complexity, similar to national trends. The other four values were very low, and all below the national averages. The in-person surveys show that riders at the Avondale station were most pleased with the availability of parking, and least satisfied with the reliability of transit.

****

**Table 1. Peachtree Center Station Characteristics**

|  |  |  |
| --- | --- | --- |
|  | Station Averages | National Averages |
| **D Variables** |  |  |
| Job population balance | 0.06 | 0.39 |
| Entropy | 0.91 | 0.83 |
| **Urban Design** | | |
| Imeagability | 2.61 | 3.54 |
| Enclosure | 3.06 | 4.10 |
| Human Scale | 1.75 | 2.64 |
| Transparency | 2.62 | 3.07 |
| Complexity | 3.86 | 4.73 |

**Table 2. Edgewood-Candler Park Station Characteristics**

|  |  |  |
| --- | --- | --- |
|  | Station Averages | National Averages |
| **D Variables** |  |  |
| Job population balance | 0.74 | 0.39 |
| Entropy | 0.94 | 0.83 |
| **Urban Design** | | |
| Imeagability | 3.23 | 3.54 |
| Enclosure | 2.11\* | 4.10 |
| Human Scale | 2.30\* | 2.64 |
| Transparency | 1.96\* | 3.07 |
| Complexity | 4.81 | 4.73 |

*\*indicates statistically significant difference*

**Table 3. Avondale Station Characteristics**

|  |  |  |
| --- | --- | --- |
|  | Station Averages | National Averages |
| **D Variables** |  |  |
| Job population balance | 0.97 | 0.39 |
| Entropy | 0.95 | 0.83 |
| **Urban Design** | | |
| Imeagability | 2.81 | 3.54 |
| Enclosure | 1.74\* | 4.10 |
| Human Scale | 2.43\* | 2.64 |
| Transparency | 2.04\* | 3.07 |
| Complexity | 4.37 | 4.73 |

*\*indicates statistically significant difference*

## Themes

**Utilizing Iconic Waypoints**

While walking through the neighborhood surrounding the station its typical to run into a geographic waypoint. Landmarks such as the carousel at Peidmont Park, America’s Mall, the Underground-where the peach drops every New Year’s Eve, sculptures, and identifiable architecture that you can view from the street level. Buildings such as the CNN building, The Sun Trust building, The English American or Flat Iron Building, oca Cola Headquarters, and the Westin all help in directing your route as pedestrian

**A Tight-Knit, Bustling Environment**

Currently, the urban core is showing characteristics of a downtown area: dense population, dense employment offerings, and small average block size. The benefits of these attributes can be expanded upon with some attention to urban design. The one significant urban design challenge that exists in this area is the abundance of above-grade pedestrian walkways. These walkways are detrimental to the establishment of a vibrant, safe pedestrian experience at street-level

**Creating Civic Space**

Today there is an expansive Retail District that draws shoppers from all over in-town Atlanta and sets the neighborhood with a well-known amenity. To transform this Retail District from a destination into a central iconic place, the neighborhood scale and public realm has to improve. The Edgewood community needs and identify it can call its own This will be achieved through the creation of new green and civic spaces for neighborhood gathering

**Bridging Connectivity**

Currently, this neighborhood has a walk score of 68 which is considered fairly walkable according to walkscore.org. Although the neighborhood is considered safe (3.7) and attractive (3.5) per survey responses, there is still some progress to be made ”If you live near the station and you don’t walk there today, that’s kind of understandable—it’s not very pedestrian friendly—but we’re trying to work toward creating a more pedestrian friendly environment—a place where you actually want to walk ”. When the Edgewood-Candler Park is complete all the sidewalks around it will have been improved, a focus on bridging existing bike lanes to improve connectivity, and ”We’re also trying to put in a roundabout at one of the intersections next to the station which is innovative in the City of Atlanta because it would help to move traffic, but also calm traffic—it would be good for pedestrians and cyclists. So that’s something that we’re looking to do—so we are trying to improve station access off MARTA property”.

# Denver

*Brian Kenney and Justin Banks*

Denver has grown significantly since its establishment as a small mining town and has quickly become the United States 21st most populous city. With the Denver Metro area covering about 8,414 square miles its population sits at about 2.6 million. Denver’s urban area is made up of 2.3 million residents and makes it the 18th largest urban area in the United States. With high concentrations it is no wonder planners and city officials have made transit, and transit oriented development a clear priority in the Mile High City.

In the mid nineties Denver was experiencing a growing pains. As the city grew, its increasing population crammed the highways and streets with their cars. Denver strives to maintain its reputation as being a progressive, livable city. To do this Denver has become an incredible multi-modal city, expanding its transit system to meet rising demands with a growing population. This growth has created many new opportunities around stations concerning transit oriented development. Since light-rail first opened in 1994, Denver has seen higher-than projected ridership since its inception.

By 2014, Denver’s Regional Transportation District or RTD had completed 6 different lines, over 48 miles of track, with 46 stations being serviced by 172 vehicles.

A vote in 2004, approved billions in tax dollars to fund a massive new transit network including 122 new miles of light rail line. Whereby creating the infrastructure for the new airport line and FasTracks that will open in 2016. Moreover, in 2006 Denver created a TOD strategic plan outlining 21 areas with long range plans that included reduced parking regulation and a switch to context sensitive form-based code among other opportunities that allowed for Denver to create new transit oriented communities along these additional lines of service as well as some older lines.

With both new lines and transit oriented developments nearing completion Denver’s higher than projected ridership numbers will indeed continue to rise faster than expectations as the city becomes more available for transit riders. The new light rail line servicing the Denver International Airport will bring significant economic opportunities as the already walkable city becomes even more accessible to visitors and locals alike.

Denver’s transit system is in a time of redevelopment. Many stations’ are receiving transit oriented designed buildings to create a stronger relationship with the services provided and the people wishing to live closer to transit. Two clear examples are the station’s 10th and Osage Station and Alemeda Station, which were both under heavy construction during our visit. Both of those stations were seen as blighted by many of the riders and according to our interview with Patrick McLaughlin now seems like new centers for growth, despite only being partially finished during our trip.

While the future looks bright for Denver’s transit systems, the revitalized Union Station is one of the best examples of the many TOD projects currently under way in Denver. Offering residents and visitors a hotel, a bar, restaurants, and an early 20th century lounge area in the main terminal of Union Station. The renewed union station is an intermodal hub that serves as the one the main connections as well as a destination in it of itself. Located between Denver’s Central Business District and the trendy LoDo, lower downtown, neighborhood, it also boasts a new neighborhood, called Riverfront to Union Stations’ west, where much of the new transit oriented development is occurring. Although recent development has been met with much success, past examples of TOD in Denver have not been seen as successful as they’d have hoped.

One such station is Englewood. Located on the South-West Line which was opened in 2000. Englewood was built to be one of Denver’s first transit oriented communities. However community approved design standards caused many issues and made it a challenging development. One such issue is a towering brick wall that separates the existing neighborhood from Englewood development. Surrounded by auto-oriented development creates particular barriers, however with a Walmart as the main attraction of this area it is difficult for any other retail to exist. Ground-floor commercial units struggle to stay occupied. Being one of Denver’s first transit oriented developments, it was a major learning lesson for planners. While it does boast a very high occupancy rate for residences, that is likely due to the low density of 3,209 residents within a half mile radius of the station. Englewood is a charming neighborhood because of its age and suburban location but it also incorporates many basic elements of transit oriented communities that make it a walkable gem in an auto-dependent desert.

Unlike Englewood which disperses its residents over a larger spec of land, the 20th and Welton station is home to The One Lincoln Park building. This area has many of the characteristics of a transit oriented development however because of the surrounding area, which is mostly filled with surface parking lots and roads, it is merely transit adjacent. Filled with exclusive condos and a garage for private parking, the bottom floors only occupant is a local bank. The towering building does little to match the convergence of the three neighborhoods surrounding it: North Capitol Hill, Five Points and the CBD. A strategic plan created in 2014 called Transit Oriented Denver found that this area has a medium to high market readiness for TOD and medium to low development potential, mostly due to the older Five Points’ neighborhood to the north of the station. But as the study concludes, as well as what led us to this station, was that it is given the high marks as far as transit oriented development characteristics are concerned. A planner working for RTD, Patrick McLaughlin, noted that this area was soon to be lush with new transit oriented developments.

## The Stations

Located on the southwest line, Englewood was Denver’s first attempt at a TOD using the standard ground-floor commercial with residential located above was successful in filling its residential units. However many commercial vacancies plague this site. With a large focus park and ride because of the suburban nature of the city of Englewood this TOD has more parking than is probably necessary. As can be seen in Figure 1.1. Englewood has been an important lesson for the planners of Denver. As Patrick McLaughlin described, it taught them what not to do when planning a TOD. While the future of Englewood is blighted by a lack of density, it does have the highest job/population balance and entropy scores of the three stations we studied. These two factors as well as being one of the oldest TODs in Denver led to its selection. These two factors as well as being one of the oldest TODs in Denver led to its selection.

Located between three different neighborhoods, North Capitol Hill, The Central Business District, and Five Points; the station at 20th and Welton boasts the smallest block size of all three stations we studied. With a new high rise building just steps from the station, and more possible development in the future shown by the amount of surface lots located around the station, this area is primed for TOD, but was not what we were expecting as far TOD is concerned. Yet, the station does offer an interesting look into a downtown station that as Patrick McLaughlin described as one the next big TOD projects that Denver is planning.

The station is most notably different than the other two because of its very high population density and job density, which ultimately led to its selection along the Welton Loop. This area was seen as an important case study in the downtown because of how it varied from Union Station and many other TOD sites were not completed. Despite lower than average marks than almost all national averages. Figure 2 shows the one category that 20th and Welton was higher than the national average was the based on interaction question in the built environment survey and fare price in the transit survey. However 20th and Welton averaged lower scores than the other Denver stations, both surveys when checked for analysis of variance, the difference was not statistically significant. Meaning that the dissatisfaction is within the expected levels of the survey results and this station was statistically speaking no different than the other Denver stations or the national averages. Figure 3 shows a similar pattern of lower than the national average satisfaction scores but is also not statistically significant. We found it to be somewhat comical that a station with so much surface parking present and such low car ownership would be so unhappy about the parking available around the station.

Union Station is one of Denver’s most prominent and ambitious projects involving TOD. Located just west of the CBD and south of the Lower Downtown neighborhood (LoDo), Union Station is one of the best examples of TOD in the mountain west. With the highest destination accessibility scores of all three stations it is no wonder so many people are flocking to this inter-modal hub that will soon have the new airport line finished, whereby connecting it to one of the farthest destinations as well. Given the fact that Union Station is located so close to the CBD it is no surprise that as figure 7 shows, it has a very poor transit share score. But has a high walk score. Between the 3 stations the correlation between walking and driving has an r value of r=-1.0, and it shows in the built environment. When people can walk more, they will give up driving. Smaller blocks and higher intersection density enables people to walk more, such was the case at both Union Station and 20th and Welton

Given that the built environment price scored the lowest in all of Denver it is no surprise that even in its wealthiest downtown neighborhood that this stayed true, and unsurprisingly a downtown inter-modal hub does not lend itself to interaction such as figure 8 shows. But it does rate very high in accessibility for the same reasons. Every score in the transit survey as shown in figure 3.3 is higher than the national average. After running a T-test on the average scores of Union Station’s transit satisfaction surveys against the national averages for the same questions it yield a p value of p=.06 meaning that it is not a statistically significant difference. However, it was very close to a statically significant difference; but close does not count. Given the nature of an inter-modal hub it is no surprise that service and reliability were rated so high, yet considering the amount of construction and immediacy to downtown the high parking score is somewhat unanticipated

**Table 4. Englewood Station Characteristics**

|  |  |  |
| --- | --- | --- |
|  | Station Averages | National Averages |
| **D Variables** |  |  |
| Population Density (sq.mile) | 3,274 | 10,992 |
| Housing Density (sq.mile) | 1,202 |  |
| Employment Density (sq.mile) | 6,766 | 29,859 |
| Job population balance | 0.388 | 0.385 |
| Entropy | 0.868 | 0.828 |
| Average Block Size (sq.mile) | 0.009 | 0.631 |
| Intersection Density (sq.mile) | 132.7 | 356.2 |
| Job Accessibility (within 45 minute drive) | 211,574 |  |
| **Urban Design** | | |
| Imeagability | 3.62 | 3.54 |
| Enclosure | 2.45 | 4.10 |
| Human Scale | 1.7 | 2.64 |
| Transparency | 2.28 | 3.07 |
| Complexity | 4.85 | 4.73 |

**Table 5. 20th and Welton Station Characteristics**

|  |  |  |
| --- | --- | --- |
|  | Station Averages | National Averages |
| **D Variables** |  |  |
| Population Density (sq.mile) | 11,590 | 10,992 |
| Housing Density (sq.mile) | 5,766 |  |
| Employment Density (sq.mile) | 84,680 | 29,859 |
| Job population balance | 0.127 | 0.385 |
| Entropy | 0.65 | 0.828 |
| Average Block Size (sq.mile) | 0.005 | 0.631 |
| Intersection Density (sq.mile) | 204.5 | 356.2 |
| Job Accessibility (within 45 minute drive) | 291,492 |  |
| **Urban Design** | | |
| Imeagability | 3.41 | 3.54 |
| Enclosure | 1.9 | 4.10 |
| Human Scale | 1.8 | 2.64 |
| Transparency | 2.58 | 3.07 |
| Complexity | 3.77 | 4.73 |

**Table 6. Union Station Characteristics**

|  |  |  |
| --- | --- | --- |
|  | Station Averages | National Averages |
| **D Variables** |  |  |
| Population Density (sq.mile) | 7,668 | 10,992 |
| Housing Density (sq.mile) | 4,045 |  |
| Employment Density (sq.mile) | 33,700 | 29,859 |
| Job population balance | 0.203 | 0.385 |
| Entropy | 0.639 | 0.828 |
| Average Block Size (sq.mile) | 0.007 | 0.631 |
| Intersection Density (sq.mile) | 158.9 | 356.2 |
| Job Accessibility (within 45 minute drive) | 293,086 |  |
| **Urban Design** | | |
| Imeagability | 3.85 | 3.54 |
| Enclosure | 2.72 | 4.10 |
| Human Scale | 3.07 | 2.64 |
| Transparency | 2.98 | 3.07 |
| Complexity | 3.64 | 4.73 |

## Themes

Developers can benefit from modified zoning when building near transit, typically these benefits manifest themselves as increased density or a parking standard reduction. And while some developers are able to use these benefits to build great TODs, others choose to use these as ways to just build better projects rather than use transit as the amenity it should. This was the case with the 20th and Welton station. With the newly constructed, One Lincoln Park adjacent to station it looked like this station was getting a new TOD infill building, however, while some residents may consider living on top of transit a value, the developers did very little to actually focus the building on the station. Despite an interesting design, with ground floor retail space, enclosed parking in the mid-section of the building, and many amenities in the building itself, One Lincoln Park, looks like a good TOD, however, the only pedestrian access to both the building and the retail are located on the opposite side of the building from the station. This is just one of the many choices that the developers made when constructing this building to show how little attention was paid to the station. Coupled with a lack of affordable housing in one of downtown’s poorest neighborhoods, we found that 20th and Welton was far from the TOD we expected it to be. During our conversation with Patrick McLaughlin, he pointed us to other projects that better exemplified the attributes that we so commonly consider TODs while suggesting that the Welton area will be one of the next challenges that Denver tackles to create more transit oriented communities throughout the region, however it is not yet what the city is looking for in a place centered around transit.

These transit oriented communities and developments such as the community that is forming around the 10th and Osage station and the development at the Alemeda Station are still under construction, but the basics are already in place and the sense that these stations are the nucleus for the community that is growing around them. What were once seen as blighted and dangerous neighborhoods are now growing into thriving areas that have use Denver’s new form based code and other aspects of the Transit Oriented Denver Strategic Plan to implement new growth in communities based around the use of transit. Despite the numerous other issues with Denver’s first real TOD, Englewood, it is clearly not a just a transit adjacent development like 20th and Welton as can be seen from the survey data. The mode of respondents’ zip codes from where their trip originated was where the station was located as opposed to 20th and Welton where the mode of respondents indicated that they were from an area just north of the station and only one respondent indicated that they were from the zip code where the station is located. From this, we can assume that Englewood is a better example of TOD, based on the fact that people from the area use transit and at 20th and Welton, we do not have the data to support that people do the same.

It is in this way that planners must check to make sure that development around transit stations are compatible to the future design of the community. The strategic plan, Transit Oriented Denver tries to remedy this situation by forecasting areas that are primed for transit oriented development, but fails in its prevention of warning that transit adjacent development can block these future TODs by allowing incompatible uses in areas that need to be designated as for transit oriented development by local or regional municipalities to prevent stations such as 20th and Welton from becoming a transit oriented community.

**Pedestrian Access Creates Better Places**

Given the in-fill nature of many transit oriented developments creating walkable places around existing infrastructure can be a challenge that some communities excel at and others fail. Denver as a whole does a good job with creating ways for people to get from the platform to their final destination. One of the best examples we witnessed was at Union Station. With two pedestrian bridges over both heavy and light rail to the north and the south of the station, each bridge is accessible to multi-modal travel (automobile excluded) and their terminus leads to wonderful public spaces. Namely to the south of the station is Denver’s Millennium Bridge. With ramps for bicycles and elevators for improved accessibility, and a modern design that assists with snow mitigation the bridge is a destination in it of itself. However it is the public spaces that are located on both sides that are more impressive. Located to the east of the bridge is a transit oriented community that houses both Riverfront and Commons Park and boasts an area with a plethora of ground-floor commercial sites with nary a vacancy in site. Home to many restaurants, cafés, and bars as well such neighborhood commercial industries such a hair salons and dry cleaners, the area also has numerous other amenities as well. A large open space common area with movable furniture and water features as well public art are all proudly displayed at the eastern edge of the bridge and when one walks down towards the area they become a spectator of the events that are happening below them. Moreover, to the west is Denver’s 16th Street mall. With bus rapid transit running every few minutes along the entire length of the mall, the mall itself is the main amenity to the west, however the impressive walkway that connects to Union Station at this end of the bridge is filled with large open spaces and public art. With such wonderful amenities to both the east and west it was no wonder that we witnessed higher than average pedestrian counts around the bridge, and while some of this could be seen as bottlenecking cause by

From what we witnessed, these people were typically not walking to or from the bridge, but rather in the area around bridge. This was most noticeable in the TOD to the east of the bridge. This was also the case for the bridge north of Union Station as well. While the pedestrian counts were not nearly as high because of the lack of amenities but the people that were out were enjoying the community that was served by the bridges that connected them to Union Station. This could also be seen at Englewood Station. Where a change in elevation between the community and the train platform was present, the community put in a pedestrian bridge to span across a roadway as well as connect to community. Again here, there is a large community space with public art and greenscaping, enclosed by ground-floor commercial with housing located above the commercial. While Englewood is less successful in the occupancy of these commercial spaces, the built and physical form of the community is typical of Duany’s Traditional Neighborhood Design as well as TODs. One of the main differences as far as built environment is concerned between these two TODs is street connectivity. Another important factor in pedestrian access. While the TOD at Union Station has some of the same flaws as Englewood such as streets to nowhere and pervasive street walls, the connectivity of these two communities are very different.

Union Station has almost 30 more intersections per square mile more than Englewood and that is not factoring in that Union Station has 2 large parks factored in this number. Because of this there is more opportunities to take different routes to the same destination allowing for a better community places as Jane Jacobs suggests inThe Death and Life of Great American Cities These two factors when used together will create better places that people will use more often and think of as amenities when choosing a place to live. Therefore, where impermeable barriers exist planners should look for logically placed access points to allow for areas where congregation can exist on both sides, while mindfully making sure that people would walk in these areas based on the connectivity of the area. While also taking into account those that need access points to reach their final destination. Such as at Englewood where the bridge only connects to the platform to eastern TOD site and does not allow access to the west where, unsurprisingly there is no development since it is unreachable.

**The Importance of Great Central Stations**

Union Station is different than most transit oriented communities for numerous reason. Namely, that it is the inter-modal hub for all of Denver’s transit services. Other reasons is the proximity to the central business district, and how much of the space to its west was grey-field. As Patrick McLaughlin said in our conversation, “It is not every day that a city opens up 11 acres in its downtown for development.” For these reasons Union Station is quickly becoming Denver’s top TOD, if not one of the best in the world. The almost absurd density at which they are building around the station is unparalleled, and was one subject that Mr. McLaughlin could not stress enough. Despite all of the building that currently under construction, there are just as many more planned to continue the in-fill process in the area.

However, the stations strength is not just with density that is being built but rather the diverse mix of uses that are being built. Hotels, offices, a grocery store, residences, and ground floor commercial associated with all of it, means a new neighborhood that follows Duany’s Traditional Neighborhood Design, just on a huge scale. Yet, Union Station itself offers all of these amenities already with-in the station just to further prove what smart transit oriented development can create from an area that has largely remained unchanged since its inception. To Union Station east the portion of buildings that were historical in our randomly selected street design audits were around 150%-200% when looking at both sides simultaneously. Meaning that much of this area of the CBD has not seen the large scale redevelopment that other sections have to provide more or better office spaces in Denver’s downtown. Using Denver’s model of how Union Station was rebuilt using existing infrastructure as well as new infrastructure is not something that every city can do, however every city should attempt to create great central station in their own way. With the creation of these downtown focused inter-modal hubs as transit oriented communities in different cities the strength of smaller TODs will also grow as more people will see the benefits associated with living near transit. One of the most important factors that has yet to be completed in Denver but is in development is connection to the airport. This may the most important factor in creating a strong central station as it relieves the tourist from having to worry about how to get to and from their two main destinations. Especially given the distance of Denver’s airport from its CBD. Denver’s focus on improving its central station cannot be understated. Much of our conversation with Patrick McLaughlin was focused on the successes and challenges that Denver and developers, alike, faced. That being said there are not always opportunities like this in every city, however that does not mean that there are not aspects that other cities cannot take from Denver’s Union Station.

More cities should focus a tremendous planning effort on improving their central stations as create a more vibrant and full time community around them. Too many central stations lack connectivity to major means of transportation such as air travel or lack the residential component that Union Station is able to balance. The two main mechanisms that allow for this to work is the high density allowed not only with in the CBD but also the strategic plan that creates these densities along with a switch to form based code allowing for better designs and more compatible, non-single use buildings.

**The Suburban Auto Oriented TOD**

As transit oriented communities move further and further away from downtowns many different situations arise. One of the largest problems is that in areas like Englewood, they are fully built suburban communities where almost all trips are based around the automobile. With a drive-mode share of almost 80% it is hard to imagine how susceptible these communities can be to receiving a transit oriented community. Englewood was one of Denver’s first attempts at a TOD and by most claims successful. By most standard metrics it scores quite highly in terms of design, however given the nature of city of Englewood it has numerous problems as well. One of the main problems with the station is a large focus on providing enough park and ride parking within the closest proximity of the station. With many large precariously placed surface lots around the station it is hard to see how the station scores so high in so many design categories.

Yet, these challenges are faced by many planners when creating transit oriented developments in traditionally suburban neighborhoods. One of the largest problems in these conditions are suburban parking standards tend to be much higher or at least land values tend to be lower so parking almost never pencils. Other problems that were present at Englewood that created an incongruent neighborhood feel was that with the addition of the transit oriented community into an existing single family home community the residents asked for a wall to be built to mitigate the density that was proposed in the TOD. The wall is almost 12 feet tall, brick, and has few openings to allow these two neighborhoods to intermingle. While the wall was probably a compromise that neither party wanted in its current form, it defines two very different neighborhoods within the same community that should never be replicated in any future projects in Denver or anywhere else for that matter. To prevent this us versus them mentality, TOD when inserted into existing communities should do more to highlight the amenities that the newer neighborhood will be able to provide to both new and old residents alike. To accomplish this including parks, public spaces, and other areas that are not just for one group of residents is important. That being said, it is important to not give too many concessions to residents of the suburban neighborhood where the TOD will be placed. Denver’s strategic plan for TOD gives developers considerably more tools than they had when they built Englewood, Mostly because of the glaring failures that are present in Englewood.

Like mentioned previously, pedestrian bridges can produce a great sense of place and where they terminate can make create better places However at Englewood, the pedestrian bridge terminates into a traffic circle. In this instance they have failed to prioritize pedestrian access above that of the automobile and the area is struggling because of it. Many of the prime ground-floor commercial spaces that are at the terminus of the pedestrian bridge remain empty because of this. The common area is more for automobiles than people and it shows.Another issue along this same vein is the placement of surface lots.

Surface lots are a necessary evil in suburban development, and can be great spots for future growth in terms of in-fill once land values reach a point where structured parking works finically, but many streets in Englewood are lined with surface parking with a grass median between the parking and the road. The lack of the sidewalk shows how the pedestrian valued less than the car. This is why, specifically in these types of suburban TODs, that transit and pedestrian uses are prioritized over that of the automobile.

**How Density Supports Mixed Use**

Both Union Station and Englewood attempt to create a mixed use transit oriented community with very different results. Union Station is very successful and Englewood is less successful. While on paper, Englewood has a higher job/population balance and higher entropy these do not necessarily yield the results that would be expected. Ground-floor commercial vacancies plague Englewood while nary a for lease sign is present in the heavily under construction Union Station. The main difference is a presence of a larger twenty-four population around Union Station that creates more demand for more services. But given the scale of both neighborhoods, Englewood should not be lagging as far behind Union Station as it is. Planners should recognize how these densities can affect how the built environment should be shaped.

While Duany’s Traditional Neighborhood Design would recommend that ground-floor commercial should be present to create a better place, but there cannot be too much of it as to create too many vacancies. In some cases communities subsidize these commercial rents to allow for incubator retail to start and grow their businesses, however in this case, it is doubtful that this will work because of the presence of a Wal-Mart within the Englewood TOD. Big box retailers, have been killing Main Street retailers for years and states like Vermont have created regulations to prevent them from doing so but the sales tax created from these stores are sometimes too good to give up. But if it means creating unsustainable neighborhoods, these concessions cannot be made. Union Station is definitely unique, but as stated previously, the focus on this new area is to create as much density as possible. And this is what all TODs should be looking to do; specifically, creating residential density. While also maintaining a high job/population balance. Union Station scores significantly lower than Englewood in this regard because of how many jobs are located around the station and how few residences there are, in comparison. The same is true with entropy scores for these two stations, many of the jobs in the CBD are similar whereas Englewood is much more diverse in this way. However, this just means that while Union Station is expanding it needs to offer a more diverse mix of jobs within the CBD. Hopefully with the move from Euclidian to Form Based Code, they are able to offer these diversities around the station. Similarly, Englewood needs to increrase housing density to support the existing commercial infrastructure. This is a challenge given the current built environment characteristics. But, there are possibilities to the West and surface parking lots for increasing their housing stock to a more sustainable level. Planners should look at these two very different stations and come to the conclusion that adding as much density to a TOD will only help add to its success.

While density is typically attacke d by NIMBYism it cannot be understated how much it affects the ability of an area to succeed in the long term. And if we are lucky zoning codes are only revised every ten years or so, meaning that in the current market the density may seem too large given the market but over time it may be much too small and it will be too late once the development is already built to remedy the situation, as may be the case in Englewood.



# Los Angeles

*Matt Miller and Sharif Mahmud*

This section investigates transit oriented development around three light rail stations in Los Angeles. All sites were required to be located at light rail transit stations. The Center for Transit Oriented Development’s station database provided ~144 stations, of which 58 were light rail stations. No station scored highly in selection criteria, with no light rail station with a score greater than 1, out of a possible 6 points. Based an evaluation of the aerial images of the built environment around the stations using Google Earth, the following stations were short-listed: (i) Long Beach Transit Gallery (ii) Redondo Beach (iii) Heritage Square/Arroyo Station (iv) Soto Station (v) Anaheim (vi) Artesia Station and (vii) Compton. Following this, additional reading and study about the potential TOD sites suggested that most of the sites were along the Blue Line to Long Beach, and multiple sites along the same line would facilitate surveying, and make it possible to interact with a single municipal jurisdiction. On the basis of which, the Long Beach Transit Gallery, Anaheim and Compton stations were selected. Further research strongly suggested that Compton would be too dangerous to visit, but that Del Mar Station in Pasadena represented a highly regarded TOD, as well as an excellent example of Transit Joint Development (TJD). The sites to be visited were selected as: Long Beach Transit Gallery, Anaheim Station and Del Mar station.

The purpose of cities is to promote social interaction and economic development. Transportation as derived demand holds a key to accomplish these purposes. However, traffic congestion can thwart these attempts by forcing vehicles to give in to delays, longer travel times, and slower speeds. Traffic congestion has close ties with the city of Los Angeles. The city is served by two major highways, i.e., interstate 5 and 10, which connect it to the rest of the nation. The LA County Metropolitan Transportation Authority plays the primary role of providing bus, subway, and light rail service. By some estimates, Los Angeles is the most congested city in the USA.

Today, however, the Los Angeles region has been focusing heavily on Transit Oriented Development in recent years. A recent plan of this region stipulated that more than 50% of employment growth and housing development between 2008 and 2035 will occur within a half mile of a well-serviced rail- or bus-transit stop in order to decrease automobile usage and increase usage of transit (Southern California Association of Governments, 2012). In line with this goal, the LA Metro has provided funds for six new light rail transit (LRT) lines that area scheduled to open by 2019.

## Stations

Del Mar Station is an at-grade station on the Gold

line, in Pasadena. Pasadena is an affluent city, historically a commuter rail exurb of Los Angeles, and currently an affluent automotive suburb. Currently, the Del Mar Station connects to the rest of the region to the popular Old Town Pasadena shopping and entertainment district. The Del Mar Station is a famous example of Transit Joint Development. Del Mar Station is the location of a historic railways station and rail yard, for the Santa Fe Railroad. Two parcels adjacent to the station, totaling about 3.56 acres was redeveloped into 347 apartments, 11,000 feet of ground floor retail, a public plaza, and 600 underground parking spaces. It was completed in 2007 (Los Angeles County Metropolitan Transportation Authority, n.d.). The apartments are built at relatively high density, rising between 4 and 6 stories, and include a ‘bridge’ portion across the train right of way. It has a very high level of finish, including good public art, a number of amenities. Restaurants do well, but purely retail spaces are vacant. Nearby locations include the Pasadena Central Park and Old Town Pasadena.

Frequency

The Gold Line light rail runs from Pasadena to East Los Angeles and vice-versa via Downtown Los Angeles serving several attractions, including Little Tokyo, Union Station, the Southwest Museum, Chinatown, and the shops of Old Town Pasadena. The northbound rail provides service (Monday through Friday) from Atlantic, East Los Angeles to Sierra Madre Villa, Pasadena approximately every 20 minutes from 4:21-5:42 AM. Then, from after 5:42 AM the frequency of service picks up: the rail runs every six minutes until 3:03 PM. Similarly, it serves every six minutes from 5:45 PM to 2:03 AM. On the other hand, the southbound rail provides service on weekdays every six minutes 7:45 AM to 4:00 PM and then, 6:30 PM to 2:09 AM. During weekend and holidays, the northbound rail provides service every 7 or 8 minutes from 9:54 AM to 12:43 AM, while the southbound rail follows the same frequency 10:35 AM to 12:58 AM. The rail runs intermittently beyond this period.

Among 36 respondents, 61% was male and the rest (39%) was female. Young people who belongs to the age group of 26 to 35 years are predominant (40%), which loosely indicates that this group is using the transit more than other age groups. Larger share (60.61%) of the respondents live in rented houses, rather than owned houses. Average of the number of vehicles available gives a value of 2.33, which reveals that, on an average, the respondents have one vehicle available to them and their households. Average response for number of trips in the last week provides a value of 6-10.

Pros and cons of living close to transit station provided very limited data as many people ignored that section. From the data that has been gathered people mentioned convenience and walking distance to transit as pros, whilst noise coming from the train as cons.

In case of satisfaction of the immediate neighborhood, people are mostly satisfied with the safety of the neighborhood (Average of 4.67) for walking, while they are relatively dissatisfied with the housing price (Average of 3.44). Average satisfaction is found to be highest (3.82) for frequency of the transit service, while it is lowest (3.18) for transit fare. Average neighborhood satisfaction among the respondents in Del Mar station falls short of the national average in five indicators, i.e., safety, crime, attractiveness, ease, and housing, while it shows greater satisfactory in rest of the indicators (Figure 1.3). Satisfaction about reasonable housing price shows a stark contrast: average satisfaction for housing price in the immediate neighborhood around the station is about less than 1 compare to the national average. Besides, overall satisfaction of the neighborhood is also lower than the national average, which indicates that people are have dissatisfaction about a lot of the issues related to the neighborhood surrounding the station. By contrast, average satisfaction for the indicators of transit service satisfaction show a better score in every aspect compared to the national average. As mentioned earlier, people have high satisfaction about the frequency of transit service. Similarly, overall satisfaction for the transit service is also significantly higher than the national average.

Anaheim Station is on the Blue Line. Anaheim station is located at the far southern end of the Blue Line. The Blue line forms a 1-way loop around Long Beach’s ‘Downtown Core’. The loop is only ¼ mile wide and ½ mile long, but has five stations along it, which dilutes the ridership between stations, and effectively represent a single station. Anaheim station is located just north of the loop, where the light rail ends two-way operation. Long Beach Boulevard was historically a major highway between Los Angeles CBD and Long Beach. It was a major through-way during the advent of the post-ware automobile age, characterized by car dealerships and auto repair shops. Additional development since that time is consistent with its function as a primary arterial, and it has accumulated large amounts of convenience retail. Following decades of use, those depreciated building are becoming vacant, and used by a variety of low rent uses: Dollar stores, tattoo parlors, ethnic restaurants, and non-profit offices. Following decades of ‘slum clearance’ and the demolition of housing, Habitat for Humanity is helping infill vacant lots by building small lot single family homes in the neighborhood. The only other form of recent redevelopment consists of a form of quasi-high density residential: a 6 story senior center.

Among the 50 respondents, 64% was male, while the rest 36% was female. Young people that fall within the age group of 18 to 25 have the largest share (36%) of respondents. The next largest is the age group of 26 to 35 years. In case of housing tenure, people living in rented houses shows a staggering 97.7% of total housing tenure. Average number of vehicles for this station gives a value of 1.69.

Figure 3.1 shows that a large share (72.34%) of the trips originated from the home, while work is the destination for largest share (67.65%) of the trips toward destination. A substantial share (59.57%) of the respondents walked to the station. Data on mode of transportation from origin and place of origin of the trips indicate that a substantial share of the respondents live close to transit station. Similarly, a large percentage (54.76%) of the respondents would use walking as a mode of transportation to reach the destination from the station. Identical to the mode used to reach station from the origin, transit was used a second most favored mode to reach the destination.

In case of neighborhood satisfaction, the neighborhoods surrounding the Anaheim station lag behind to the national performance in 5 of the 10 indicators of neighborhood qualities. However, respondents give overall satisfaction of the neighborhood quality a higher average rating than the national rating. A stark difference can be seen in the between Anaheim station and national neighborhood satisfaction level in terms of safety of the neighborhood for walking. By contrast, transit service shows a better satisfaction level compared to the nation. People ranked frequency of the service as highly satisfactory aspect of transit service. Similarly, people responded with a high rating for overall satisfaction compared to the nation, which is higher than point 1 in terms of average satisfaction.

Long Beach Transit Gallery is on the Blue Line. The Blue line was the first light rail line to be built in Los Angeles. It is also one of the first light rail lines to be built in the United States. The Blue line was originally intended to reach from Willowbrook (from about I-105) to Downtown LA. According to the Longbeach City Planner, agitation on the part of Longbeach for the line to connect to downtown Longbeach resulted in the extension of the line to the City of Longbeach. The Long Beach Transit Gallery station is at the Southern end of the Blue line 1-way loop. The light rail station was sighted in this location because the ‘Transit Gallery’ was already the central bus terminal for Long Beach Transit’s bus services.

The station is located in downtown Long Beach. Initially developed as a resort and recreation destination connected to downtown LA by the ‘Red Cars’, Long Beach grew explosively with the discovery of oil. The high quality of freight access in the area, combined with the attractive harbor at the mouth of the Los Angeles River made Long Beach an attractive place for a naval base. Because of the harbor at the mouth of the LA river, Long Beach became the location of the Long Beach Naval Base and the Seal Beach Naval Base. The presence of provided both patrons for a local amusement park (‘The Pike’) and the base provided employment for the surrounding population. Much of the initial development was working class housing for people employed in Long Beach. Like most of the Los Angeles Metropolitan area, Long Beach was platted for single family detached homes, at about 4 units per acre.

During World War 2, Long Beach grew strongly, becoming a major manufacturing center for aircraft in addition to a repair and retrofit location for naval ships. The Korean War and Cold war ensured that the naval and aerospace employment in Long Beach remained robust. Following the end of the Cold War, changes in military funding resulted in a decline in the cities fortunes. The naval base ceased operations and in the 1990’s was transformed into a container port.

As the area has densified, many single family houses have been replaced by multi-family apartments on the same lots. Downtown Longbeach has experienced substantial redevelopment, in multiple phases. Like most cities, Long Beach fell prey to the fad for mega-blocks, including a justifiably reviled Brutalist ‘Civic Center’, an enclosed suburban mall, and an automotive oriented shopping/recreation/entertainment center known as ‘The Pike at Rainbow Harbor’. More successful redevelopment efforts include the Long Beach Convention Center, the Long Beach Aquarium, and the Queen Mary (a former cruise ship, and current museum/aquarium).

In recent years, Long Beach has been very effective a developing a downtown entertainment district, adding to the entertainment options offered by the the long beach itself, making Long Beach yet more attractive to conventioneer’s and tourists. Long Beach has a long history of sea-side hotels, but with the Pike at Rainbow Harbor, has begun to add higher density residential.

**Table 7. Del Mar Station Characteristics**

|  |  |  |
| --- | --- | --- |
|  | Station Averages | National Averages |
| **D Variables** |  |  |
| Population Density (sq.mile) | 9,420 | 10,992 |
| Employment Density (sq.mile) | 31,840 | 29,859 |
| Job population balance | 0.228 | 0.385 |
| Entropy | 0.898 | 0.828 |
| Average Block Size (sq.mile) | 0.007 | 0.631 |
| Intersection Density (sq.mile) | 211 | 356.2 |
| **Urban Design** | | |
| Imeagability | 5.18 | 3.54 |
| Enclosure | 6.88 | 4.10 |
| Human Scale | 3.13 | 2.64 |
| Transparency | 4.68 | 3.07 |
| Complexity | 5.1 | 4.73 |

**Table 8. Anaheim Station Characteristics**

|  |  |  |
| --- | --- | --- |
|  | Station Averages | National Averages |
| **D Variables** |  |  |
| Population Density (sq.mile) | 16,110 | 10,992 |
| Employment Density (sq.mile) | 44,260 | 29,859 |
| Job population balance | 0.274 | 0.385 |
| Entropy | 0.766 | 0.828 |
| Average Block Size (sq.mile) | 0.003 | 0.631 |
| Intersection Density (sq.mile) | 228 | 356.2 |
| **Urban Design** | | |
| Imeagability | 0.03 | 3.54 |
| Enclosure | 0.19 | 4.10 |
| Human Scale | 0.03 | 2.64 |
| Transparency | 0.27 | 3.07 |
| Complexity | 0.23 | 4.73 |

**Table 9. Long Beach Station Characteristics**

|  |  |  |
| --- | --- | --- |
|  | Station Averages | National Averages |
| **D Variables** |  |  |
| Population Density (sq.mile) | 28,480 | 10,992 |
| Employment Density (sq.mile) | 6,292 | 29,859 |
| Job population balance | 0.674 | 0.385 |
| Entropy | 0.751 | 0.828 |
| Average Block Size (sq.mile) | 0.003 | 0.631 |
| Intersection Density (sq.mile) | 203 | 356.2 |
| **Urban Design** | | |
| Imeagability | 3.3 | 3.54 |
| Enclosure | 10.49 | 4.10 |
| Human Scale | 2.23 | 2.64 |
| Transparency | 6.78 | 3.07 |
| Complexity | 4.95 | 4.73 |

**Pedestrian Oriented is Pedestrian Scaled**

To be perceived as a ‘room’, a place must have enough of a sense of enclosure. Enclosure requires something to bound a space, to determine where a space can be said to begin and end. As a room requires enough of a sense of enclosure to be perceptible as a room.Experts suggest that it is the ratio between the building height and the street that generates a sense of enclosure, suggesting a ratio of at least 1:2. But a 100’ wide street bounded by 50’ tall buildings does not generate a sense of enclosure. Rather than the ratio of buildings to the street, it is the ratio of height and width to the pedestrian that generates the sense of enclosure. Tall buildings, set back from the sidewalk, generate enclosure at a more geographic scale, rather than a habitation scale. They are almost more landscape features than structures--generating the sense of being in a Canyon. In Long Beach, there are many tall buildings along Ocean Boulevard, but only when there is a matched set of buildings accros the street from one another do they generate any sense of enclosure. The presence of surface parking adjacent often prevents this from happening.

A sidewalk along an arterial street can never generate a room; five lanes of traffic (with sidewalks) generates a space over 72’ wide, over 12 times the height of a tall person. The absolute maxima seems to be about 50’--enough 3 travel lanes with large sidewalks, or 4 travel lanes with minimal sidewalks. The setback from the sidewalk to the building facade is key. The setback between the building and the sidewalk adds to the effective width of the street. A 10’ setback along 11th street near Anaheim station eliminated most of the feeling of enclosure from a 50’ buildings.

Pedestrian scaled environments are often pleasant regardless of other conditions. An industrial access alley to the rear of the Humane Society near Del Mar Station proved to be a surprisingly pleasant location simply due to the degree of enclosure. The buildings were all single story warehouses, with an average height of 20’. But the distance between the warehouses was likewise about 20’. Built on long skinny lots, they created a corridor, a long skinny ‘room’ between the buildings.

**Transit Line is Not a Moving Walkway**

Mass transit does not, and cannot, provide on-demand transportation. All transit trips require waiting for a vehicle. It is vehicles that provide access, not stations; More stations is not more access. When the Blue Line was out of service for repairs, Long Beach Transit Mall station was almost abandoned. Increasing the amount of track to increase the lots fronting on the track does not always increase access. Often, in downtowns, there is a strong desire for a ‘pedestrian circulator’--some sort of transit system that can increase the area that is part of the walkable Central Business District. Most CBD’s are very dense, because the amount of area within a walkable distance is very limited. The desire to expand the extents of the central city that are accessible by walking is what drives the demand for ‘People-Movers’ like mono-rails and other ‘Personal Rapid Transit’ systems. But mass transit systems cannot provide the on-demand services that taxis or jitneys do--they are designed to provide transportation to groups of people, rather than individuals.

Improving walkability within the central city cannot be accomplished by mass transit. Mass transit can provide accessibility to the central city, and to destinations within the city too far to walk to. But when considering places close enough to walk to, it does poorly. If it’s faster to walk than to wait and to ride, almost everyone walks. In downtown Longbeach City, one station is so under-used as to be abandoned because it is too close to another station. Improving walkability within the central city can be accomplished by improving the pedestrian environment. The safety, comfort and interest of a walking trip affect the percieved distance of that trip, and thus the propensity to walk. Making the central city more walkable can increase the size of the central city. This can be accomplished through the use of pedestrian oriented design. Pedestrian Oriented Design means prioritizing the pedestrian over the automobile. For example, wide roads are attractive pathways for cars, but barriers along pedestrian paths. Roadway crossing locations at intersections are especially bad. Curb radii are often designed to speed turning movements for automobiles, at the cost of increasing crosswalk distances.

Crosswalks are dangerous places for pedestrians; competing with cars for space is unsafe. Pedestrian Oriented Design also suggests a more ‘complete’ street network, with more through streets (measured by 4-way intersections). The streets do not have to be very wide--walkways, promenades and alleys all serve. But the more streets there are, the more direct a walking trip can be. More streets means small blocks. And the more small blocks there are, the more walking is like traveling along the hypotenuse of a triangle, rather than walking both sides. Long Beach City has added a new street beyond the existing street grid. Del Mar station includes several pedestrian walkways through the building. Sidewalks along busy automobile streets are also uncomfortable because they are noisy; automobile and truck noise makes them unpleasant walking routes. At Anaheim station, conversation often became impossible. Yet, on a residential station a half-block away, birds could be heard singing.

People like to watch people. Any lively place becomes an attractive place to travel to, or to travel by. Where possible, make it possible for people to gather along an active walkway without interfering with those traveling along it. In places with few people, public art such as murals or sculptures can be used to make a journey more interesting.

**Redevelop at Higher Density**

The price of a single family house is typically about 4 times the price of the land. Yet land values typically rise over time. Land values rise significantly between the initial urbanization of a place, and the time when buildings are worn out enough to be redeveloped. Near Anaheim station, there is a large hospital where there was once a block of residential houses. Thus, when a parcel is redeveloped, it must be developed more intensively than the first time it was developed. The value of a new building is 4-10 times the value of the land. If the value of the land has doubled, new construction must be eight times as expensive as the initial construction. Thus, single family home lots are redeveloped as mid-rise apartments, not duplexes, townhomes or garden apartments. In Anaheim, in relatively low income area, new residential development still consists of elevator apartments. The value of a parcel is often expressed in terms of the rents it offers. The difference between the rents offered by the existing use of a parcel, and the rents offered if the parcel was redeveloped is called the ‘rent gap’. Typically, if the rent gap is larger than the cost of financing, redevelopment occurs.

However, for most properties, the ‘highest and best use’ for a parcel is a single family home. Zoning prohibits other development. Because property is assessed for the property taxes on the basis of its highest and best use, this helps keeps property taxes down. It also prevents neighbors from building structures with incompatible uses, heights, or sizes. While possible to rezone land for higher development, opposition from neighbors to new development (NIMBYism) effectively keeps new development out of most single family neighborhoods.

Thus, most new development takes place outside of such neighborhoods. Initially, it takes place on marginal land--parcels that were difficult to development due to slopes, streams or other geographic features. Secondly, new development begins to take place on marginally developed locations--large lots with aging or run down structures. (Development at Del Mar Station re-used the land from an old railroad depot.) Finally, re-development occurs, where existing structures are replaced by new structures with higher rents. Redevelopment tends to take place where the price of redeveloping a parcel is the same as buying an undeveloped parcel.

Expanding metropolitan areas typically see little redevelopment. ‘New’ land is made available for development through transportation improvements. Areas where expanding the metro area is difficult (due to geographic or regulatory constraints) typically have the highest land prices. Los Angeles has expanded as far as possible in every direction, but is bounded by both the Pacific Ocean and mountains. While expanding Eastward is still possible, the legendary traffic congestion of Los Angeles has become so severe that distance has become a constraint to the further expansion of the metropolitan area. With the a limited supply of land and rising demand, prices for land must rise. As prices rise, so does the value of new development. Thus, new residential development should occurr at much higher densities. This is good news for transit stations, which are one of the few locations where higher densities do not translate into higher automobile congestion.

**Retail is Never Transit Oriented Development**

As articulated by the New Urbanists, a Transit Oriented Development (TOD) consists of a “Retail and Service Core’ surrounding a transit station, and wrapped by high density residential development. The residential development provided the population to support the core, and the retail core was located at the most accessible location in the community--next to the transit station. TOD’s were intended to take place as part of a comprehensive land use and transportation planning effort. However, TOD was planned for ‘greenfield’ conditions, while most transit station are built in existing built-up areas. In that context, all transit trips compete with the automobile. This undermines the potential for Transit Oriented Development. Most locations suitable for TOD are also suitable for automobile oriented development. Because they are built in built-up areas, new transit lines had to following existing paths, such as freeways and arterial streets--which already had very good automobile access.

In real estate, there are two types of retail: Destination retail and Convenience Retail. Destination retail represents large shopping centers where people will travel long distance to visit. Convenience retail are smaller shopping centers. Most retail development is convenience retail. When shopping, people tend to visit the retail center closet to them, with ‘closest’ defined in terms of travel time.

Transit is an unsuitable access mode for retail trips; retail trips are often short, with erratic ending times, and burden the passenger with packages. Transit headway imposes a minimum travel time on all trips. Leaving work to catch the 5:04 train is possible; if the check-out line is short enough to allow you to catch the 5:04 is unknowable. More than two bags requires a vehicle; humans have only two hands. At Del Mar station, despite excellent location (adjacent to platform), the high residential density, structured parking, and success of restaurants and office along the station. Retail in Old Town Pasadena (nearby to Del Mar) is successful, but relies on automobile access. Retail cannot depend on transit access alone. Pedestrian oriented retail relies on very high levels of street traffic. Without that high level of residential density, retail needs automotive access as well.

Part of the reason for the failure of TOD is the lack of residential density at stations. As articulated by the New Urbanists, a TOD had several thousand housing units within a 10 minute walk. That amount of housing within that area required a level of residential density greater than that which can be provided by detached housing. A transit station located in a suburb (even a historic ‘streetcar’ suburb at 12-15 units/acre) does not have enough density to support retail development. Secondly, the success of retail at a TOD was predicated on the assumption that the retail at the center of the TOD would be the only retail for the residents. Because transit stations were built in an existing built up urban environment, the population was already served by competing retail developments.

In compliance with the theory of TOD, the land around transit stations has been designated for retail. Yet for the reasons articulated previously, retail near transit stations does poorly. The ‘Retail and Service Core’ of a TOD would better be described as a ‘Restaurant and Service Core’.

**Scraped Sites Sterilize**

Area near Anaheim station replete with vacant lots. Many parcels represent buildings that were demolished to clear homes that had become blighted, or become public nuisances. Yet a vacant lot itself quickly becomes blight. Unmaintained, it steadily accumulates litter, and eventually begins to function as a dump. To prevent this, the lots must be fenced. Moving the lots from government ownership back into private ownership is often difficult--either due to a lack of buyers, or public sector intertia. One vacant lot near Anaheim station had transitioned into a public garden, which is even less likely to redevelop.

Multi-parcel sites have their own problems. But large sites require large developments, which occurr less frequently than smaller developments. Big sites require big developers, so long waits can result. They typically result when a redevelopment districts are used for parcel assembly, by demolishing multiple buildings and combining parcels to create a single large parcel. This may occurr for declining residential neighborhoods, or for deteriorated commercial uses. Near the Anaheim station, both had occurred previously--when residential homes had been cleared for St. Mary’s hospital. Large sites make it possible to locate large institutions in an existing urban context (Hospitals, civic centers, libraries) but they ado not make efficient use of land--much land wasted in parking, paving, landscaping, and remnant land. Large parcels make possible suburban design in an urban context--big setbacks, lots of landscaping. More recently the parcels to the West of Anaheim station had been cleared to provide a parcel the size of half a city block. In sharp contrast, the East side of the street next to Anaheim station consisted of older, run-down structures that were in the process of being fixed up and repurposed as retail and restaurants. Like hermit crabs, people will re-use any shell they can find, but they must have a shell.

# Portland

*Grant Allen and Mike Christensen*

**Background**

Portland is known for its history and legacy for robust planning and implementing forward-thinking strategies. Part of this legacy of included the laws passed in the 1970s that established urban growth boundaries – that limited future growth past that boundary. Another important event was when residents refused to allow a highway to be built and instead the development of the TriMet light rail. Not too much later after these innovative ideas were implemented, Portland established the only regional metropolitan government (Metro) in the country. The combination of these ideas set Portland on the map. These have only succeeded in the now important policies that have been implemented in furthering transit-oriented development.

Our initial analysis included examining all transit stations in Portland, Oregon. For this analysis, we conducted spatial analysis in GIS with a half-mile buffer around each station. We then measured the most common D-variables: density, diversity, design, and destination accessibility. Completing this analysis provided us with the information whereby we would select three stations to further research and measure when we would be visiting Portland.

Our initial analysis of the D-variables of the 138 transit stations in the Portland metropolitan region gave us little help in our selection of stations. The highest performing stations were clustered in the downtown with little variation among stations as the transit system extends into the suburbs. For this reason, we abandoned using some form of D-variable ranking as a station selection method for something a little less quantitative – our intimate knowledge of Portland gained on previous trips. As our instructions called for a variety of development types among our three stations, we decided to choose one in the core of downtown, one in a suburban greenfield setting, and one in a recently redeveloped industrial brownfield.

For our downtown station, we selected Pioneer Square North, which lies in the heart of downtown and at the heart of MAX – Portland’s light rail system. The station is served in one direction by the Red Line, which heads westbound to Beaverton and by the Blue Line, which heads westbound first to Beaverton and further to Hillsboro. Nearby stations include Pioneer Square South – served by the eastbound Blue Line to Gresham and the eastbound Red Line to the airport, Pioneer Courthouse – served by the eastbound Green Line to Clackamas and the northbound Yellow Line to Expo Center, and Pioneer Place – served by the southbound Green and Yellow Lines to Portland State University. Both the North-South Streetcar Line and Central Loop Streetcar Line pass to the west and south of Pioneer Square. Several bus lines also stop nearby. Our reason for choosing Pioneer Square North as opposed to the other nearby MAX stations was simply the fact that the station was the closest to our hotel.

For our suburban/greenfield station, we selected Orenco/NW 231st, which lies in the western suburb of Hillsboro. The station is served in both directions by the Blue Line headed westbound to Hillsboro and headed eastbound through downtown Portland and finally to Gresham. The only other nearby transit is one bus route. Our reason for choosing Orenco was simply the fact that Reid could not stop talking about it in his transportation class, and we wanted to find out whether it really is as cool as Reid says it is.

For our redevelopment/brownfield station, we selected OHSU Commons, which lies along Portland’s South Waterfront. The station is served in one direction by the North-South Streetcar Line, which heads northbound through downtown Portland to the Pearl District of northwest Portland. Nearby transit stations include SW Moody & Gibbs – served by the North-South Streetcar Line to the South Waterfront before it makes a loop and heads north again – and the lower terminal of the Portland Aerial Tram, which connects the streetcar and OHSU Commons on the South Waterfront with the main campus of OHSU atop Marquam Hill. One bus route also passes through the South Waterfront. Our reason for choosing OHSU Commons is the reputation of the South Waterfront as an example of redevelopment spurred by the addition of a streetcar line. We specifically chose OHSU Commons due to its adjacency to the Portland Aerial Tram, and due to the streetcar’s loop, OHSU Commons is a station primarily for boarding, while SW Moody & Gibbs is primarily for alighting. The lower tram terminal is also noteworthy as the largest bike valet in the US.

Portland is a “planner’s mecca.” After the other research that has been done about Portland we expect the experience in Portland to be very positive. Because of its reputation, we expect Portland to be a model city. We expect our design scores to be high and that the conditions to be conducive to strong TOD development. We are also very interested to see the difference between doing the scoring in Portland compared to that of our experience of doing it here in Salt Lake City. The three stations we have selected have some similarities, but also distinct differences. We look forward to exploring each of these stations and linking the preliminary analysis and data to “on the ground” research. Based on this information we expected to find different outcomes for some of the measurements for each station that we visited.

## The Stations

Pioneer Square is the downtown station that we selected. Due to its dense urban location with its multiple transit stops and high frequency of use, we expected it to score very high in design and be an ideal location for surveys due to the number of people that frequent it.Downtown Portland is incredibly walkable. As we visited downtown first, we kept remarking how the scale of the block size, streets, and buildings made it feel like the perfect scale to walk and experience the city. Downtown Portland is an excellent example of the powerful effect that small blocks and narrow streets can have on a city’s urban environment. Even streets, the streetscapes of which were lacking as far as design characteristics go, still had a relatively high number of pedestrians walking along them.

The small blocks of downtown Portland also have an interesting effect on the light rail system. The short blocks only allow for two car trains in contrast with other light rail systems in the US, which can run up to four cars per train. The limit of two cars per train forces Portland’s light rail system to operate at higher frequencies during rush hour. Where other light rail systems add more cars to their trains during rush hour, Portland has to increase frequencies by adding more trains in order to meet the increased demand.

Pioneer Square is a very unique station when it comes to the D-variables, as discovered as our team prepared to visit Portland. Over 110 segments were identified for urban design scoring. This relates to the very low average block size and the very high intersection density. Most of the variables score higher than the national averages. It has a higher population density, 15,030 persons per square mile compared to that of the national average. The employment density, 88,220 jobs per square mile, is nearly three times the national average. With a low jobs-population balance, as well as examining population density, employment density, and the average household income, we can conclude that Pioneer Square portion of Downtown Portland is more of a jobs center than residential. We had expected to find a higher jobs-population balance for our downtown station.

The mode share for Pioneer Square was expected. A high walk and transit share supports the walkability of the neighborhood as well as the previous discussion of a higher population of workers who would use transit to and from work and then walk the rest. Generally, we also had this assumption of that the walk & transit scores would be higher than drive share for this station.

For a downtown location, the enclosure and transparency scores that we measured were interesting and encouraging for the overall walkability that was experienced. Despite these scores supporting the walkability, they are not statistically significant. The other three scores, enclosure, imageability and complexity were significant. These other scores were lower than the national average, but not by much. For a downtown location we expected these to be closer to the national average, especially the human scale and complexity scores.

The nature of Pioneer Square made gathering surveys there difficult due to the convergence of multiple considerations. The high number of panhandlers, street preachers, and solicitors cause people to be less approachable. The high frequency of transit left little time between trains. Due to the great urban environment surrounding the station, there is really no reason for riders to spend much time waiting for their train.

From the few surveys that we did collect, the data was encouraging but as we reviewed some of the results it did not support our own hypotheses that we had for our survey results. For example, walkability was the lowest score from the survey data. The urban design scores as well as the d-variables validate the high walkability of the area around the station. Yet, the people surveyed can also provide a much different real perspective of the reality of the walkability of the area, contrasted to the scores and measures that only support the possibility of walkability. The other survey results supported our hypotheses and prior research of the reliability of transit and operation hours. Additionally, the highest neighborhood satisfaction scores were for housing and destination accessibility. This could be assumed to contribute to and support the walkability hypothesis that we have for downtown Portland.

Experiencing Orenco in person was somewhat perplexing. From prior research and from our interview we expected the results to support these and our own expectations. However, it seemed to be lacking. Upon walking further throughout Orenco, we discovered that the problem was that the early stages of its development had been built – not adjacent to the light rail station – but rather along NE Cornell Road, which is a five-lane arterial. “The five-lane arterial here is rather a hard edge that really divides the development.” (interview) While the development style may carry through, we experienced this edge as one of the few places to eat near the development was across this large arterial. A portion of the development that is quaint and walkable shopping street is also located across this street and lies more than a quarter-mile away from the station.

It would appear that Orenco has been built in reverse as far as its configuration as transit-oriented development with successive stages of development moving from the arterial to the station. The good news is that there is now a flurry of construction of four and five floor mixed-use buildings immediately adjacent to the station. Even though Orenco may have been constructed in reverse, it still has been urban design characteristics than the typical suburban sprawl surrounding it. The major arterial also minimizes the possibilities of success for this area as a TOD because it greatly reduces the connectivity of the larger area, quarter-mile to half-mile buffer north of the station. Instead, it nullifies walkability and serves as a hard edge cutting off part of the development from the rest.

Much of the d-variables for Orenco are much lower than those of the national averages. This was expected as Orenco is a suburban station. Suburban stations rarely have the density that other stations would have. The d-variables supported what we found during our visit.

The mode shares for Orenco are of no surprise for the suburban development that it is. A high percentage rely on automobiles, with the next transit and walking the lowest share. This was identified with some of the comments on our surveys and with the people taking the surveys, that it was easier to drive across to another area, than ride transit in to town only to ride transit back out to that other location. Additionally, the planner that we interviewed identified this as a barrier with smaller municipalities and encouraging transit-line linking further out.

The highest score from the urban design scores for Orenco was complexity. All of the scores were lower than the national averages. Notably is that all of the scores are statistically significant. A portion of these scores were skewed from the variation in density in the buffer surrounding Orenco station. Immediately south-east of the station there is the historic Orenco which has small blocks but is very low density. Two of our random segments landed there. With a significant portion of the development that is adjacent to the station under construction, further we recommend further exploration of this station to validate the urban design scores as possible segments that could have been included in our scoring were excluded due to the construction.

Orenco proved to be much easier for gathering surveys, due to its nature as a typical suburban light rail station with an island platform that is somewhat isolated from the surrounding neighborhoods. The construction also helped as everyone had to enter the station from the same entrance. The nature of the platform meant that riders would have to spend at least a few minutes captive at the station before the arrival of the train. There was not much of a range for the highest and lowest results of the transit scores from Orenco. The lowest score was overcrowding, with many of the next values very similar scores ranging up to the highest, of overall service. The lower scores were nearly expected as overcrowding and parking are assumed to be of lower importance for a suburban station than that of a downtown location. The higher rated scores were expected to score highest as persons relying on the transit at the suburban station prioritize reliability, operation and overall service higher.

The results from the neighborhood satisfaction surveys ended up supporting our initial d-variable and station analysis. We had expected that a suburban station would have a higher score for attractiveness, low-crime and safety as those were the highest scores. The housing data that was somewhat surprising after learning that the cost of housing was a concern from the survey results. Another interesting find was that all of the neighborhood satisfaction scores were higher than the national averages. We had not expected this in every category.

For our redevelopment/brownfield station, we selected OHSU Commons, which lies along Portland’s South Waterfront. The station is served in one direction by the North-South Streetcar Line, which heads northbound through downtown Portland to the Pearl District of northwest Portland. Nearby transit stations include SW Moody & Gibbs – served by the North-South Streetcar Line to the South Waterfront before it makes a loop and heads north again – and the lower terminal of the Portland Aerial Tram, which connects the streetcar and OHSU Commons on the South Waterfront with the main campus of OHSU atop Marquam Hill. One bus route also passes through the South Waterfront. Our reason for choosing OHSU Commons is the reputation of the South Waterfront as an example of redevelopment spurred by the addition of a streetcar line. We specifically chose OHSU Commons due to its adjacency to the Portland Aerial Tram, and due to the streetcar’s loop, OHSU Commons is a station primarily for boarding, while SW Moody & Gibbs is primarily for alighting. The lower tram terminal is also noteworthy as the largest bike valet in the US.

The South Waterfront is sandwiched between Interstate 5 and the Willamette River. High-rise buildings housing luxury condominiums dominate this area. Equally as interesting for us as the high-rises was the significantly older neighborhood of Lair Hill lying just opposite of Interstate 5 to the west. We were fortunate that our quarter-mile buffer also included street segments located in Lair Hill. Most of the homes were colorfully painted and well kept, and mature trees lined the streets. The beautiful homes ranged from two to four floors and from single-family to quadplexes.

Interesting to note is the Gibbs Street Bridge, which connects Lair Hill with the South Waterfront, bridges Interstate 5, and lies directly beneath the Portland Aerial Tram. Due to the topography, the western end of the bridge is at street level with the neighborhood, while the eastern end features a myriad of steps and an elevator. The bridge, steps, and elevator provide the neighborhood with easy access across the freeway to the South Waterfront, streetcar, and aerial tram. The bridge impressed us, and we it as a great example of the investments that are often necessary to overcome barriers to access and walkability. Despite the investment in and high-rises of the South Waterfront, we were not as impressed by it as we were with the neighborhood just to the west. The South Waterfront just has not existed long enough to have developed a significant sense of place. It lacks the charming character of Lair Hill just to the west. It was also evident that the South Waterfront lacks economic diversity. The high-rises are a place for the rich, and we guessed that if we had stayed there long enough, every make of luxury car would have eventually passed by.

As the South Waterfront is still in the process of being developed, the lower than average population and housing density scores were expected. Surprising is the high number of jobs in the area. Upon visiting the area, it was obvious that OHSU Commons employs a large number of employees along with the handful of industries still located in the area.

The mode share and number of vehicles per household for the South Waterfront was unexpected. Considering the presence of the streetcar and aerial tram, a higher share of transit use would be expected. It is obvious that the residents of the luxury condominiums still own cars. Despite the high entropy scores, residents of the South Waterfront still drive to take care of their errands.

With all the high-rise buildings, it’s no surprise that the South Waterfront scores low in terms of being human-scaled. Its significantly low enclosure score is due to several vacant lots that are waiting for development. However, the South Waterfront still competes well in terms of complexity and imageability.

The South Waterfront also proved to be a difficult for gathering surveys. A rainy Saturday afternoon was not a good time for encountering people. There were few people about, and the majority of those who were there were tourists who came there to ride the aerial tram. Talking with a few locals revealed that the location is usually bustling with people on weekdays as student, faculty, and staff transfer between the aerial tram, streetcar, and move between sections of the OHSU. In addition, many of the people that we were able to survey did comment that their biggest issue with the South Waterfront is its lack of a grocery store.

**Table 10. Pioneer Square Station Characteristics**

|  |  |  |
| --- | --- | --- |
|  | Station Averages | National Averages |
| **D Variables** |  |  |
| Population Density (sq.mile) | 15,030 | 10,992 |
| Housing density (sq.mile) | 9,491 |  |
| Employment Density (sq.mile) | 88,220 | 29,859 |
| Job population balance | 0.15 | 0.385 |
| Entropy | 0.87 | 0.828 |
| Average Block Size (sq.mile) | 0.002 | 0.631 |
| Intersection Density (sq.mile) | 425 | 356.2 |
| Destination accessibility (within 45 minute drive) | 217,694 |  |
| **Urban Design** | | |
| Imeagability | 2.86\* | 3.54 |
| Enclosure | 11.1 | 4.10 |
| Human Scale | 1.99\* | 2.64 |
| Transparency | 6.12 | 3.07 |
| Complexity | 3.83\* | 4.73 |

\* *Indicates a statistically significant difference*

**Table 11. Orenco Station Characteristics**

|  |  |  |
| --- | --- | --- |
|  | Station Averages | National Averages |
| **D Variables** |  |  |
| Population Density (sq.mile) | 6,183 | 10,992 |
| Housing density (sq.mile) | 2,990 |  |
| Employment Density (sq.mile) | 1,595 | 29,859 |
| Job population balance | 0.71 | 0.385 |
| Entropy | 0.87 | 0.828 |
| Average Block Size (sq.mile) | 0.0087 | 0.631 |
| Intersection Density (sq.mile) | 158 | 356.2 |
| Destination accessibility (within 45 minute drive) | 97,877 |  |
| **Urban Design** | | |
| Imeagability | 2.61\* | 3.54 |
| Enclosure | 1.84\* | 4.10 |
| Human Scale | 2.07\* | 2.64 |
| Transparency | 2.23\* | 3.07 |
| Complexity | 3.97\* | 4.73 |

\* *Indicates a statistically significant difference*

**Table 12. South Waterfront Station Characteristics**

|  |  |  |
| --- | --- | --- |
|  | Station Averages | National Averages |
| **D Variables** |  |  |
| Population Density (sq.mile) | 5,186 | 10,992 |
| Housing density (sq.mile) | 3,318 |  |
| Employment Density (sq.mile) | 7,712 | 29,859 |
| Job population balance | 0.52 | 0.385 |
| Entropy | 0.89 | 0.828 |
| Average Block Size (sq.mile) | 0.003 | 0.631 |
| Intersection Density (sq.mile) | 249 | 356.2 |
| Destination accessibility (within 45 minute drive) | 196,815 |  |
| **Urban Design** | | |
| Imeagability | 3.52 | 3.54 |
| Enclosure | 2.15\* | 4.10 |
| Human Scale | 2.39 | 2.64 |
| Transparency | 2.40\* | 3.07 |
| Complexity | 3.54\* | 4.73 |

\* *Indicates a statistically significant difference*

## Themes

An underlying theme we wanted to research for this project was urban design and its relation to and how it supports TODs. As new development takes shape, elements of urban design are critical for the success of the specific transit oriented development site. In our case, we were able to see specific applications of how critical the elements of urban design were at Orenco and South Waterfront. Comparing both sites, the South Waterfront station scored higher in 4 of the 5 urban design scores over Orenco, as seen in the graph below. This supports multiple variables of urban design as a part of the TOD. Orenco was developed in segments starting much earlier than South Waterfront. As we measured the segments, the different segments scored differently for urban design. South Waterfront on the other hand, was a more recent development and we hypothesize that it was developed not completely segmented, but more of as an entire project with a unified design for the entire site.

**The South Waterfront’s Lack of a Grocery Store**

An interesting topic that was presented to us during our interview with our planner was that there was no grocery store in the area of the South Waterfront. During the interview that sounded interesting, and we made a note of it. It left us asking an important question: are grocery stores or grocers and important retail component of transit-oriented-development? As we explored further, we used common map tools such as Google Maps, Mapquest and Bing Maps to find the nearest grocery stores via car and transit. We identified several options not far away in downtown that would be 10 to 15-minute drive or 25-minute transit ride. If you sum the time it would take to drive, shop, load groceries, then drive home or similar chronology for taking transit, a grocery trip would be a minimum of approximately 1 hour via car or 1.5 hours via transit (assuming a minimum of 20 minutes inside the store).

Despite the high driving mode share that exists for the South Waterfront station, the idea of transit-oriented development should encourage car-less driving and transit usage. A local grocery store would further encourage this mode shift and opportunity for someone to commute via transit home and then not face a minimum of 1 hour to obtain groceries. Additionally, a grocer is often an important fixture for any community. It brings the community together, as the community would all shop there, and would bring further development opportunities to the immediate station area.

**Do urban growth boundaries foster TOD?**

Shown in the map below, Portland pioneered the idea of the urban growth boundaries establishing the first one for the tri-county area in the 1970s. This has concentrated development within the boundaries and encouraged infill and redevelopment. We consider Orenco and South Waterfront direct outcomes of this policy. The TriMet light rail project began not long after the boundary was established. We see these two project ideas at their early onset successfully laying the future foundation for the development motivation and opportunities. There are criticisms that the growth boundary limits housing affordability and open space opportunities within the boundary. From our data, it is evident that the housing affordability at Orenco is a problem with it being a low score from our surveys. The planner that we interviewed pointed out that that was a significant challenge to future TOD in the metro area. The fluidity of the market poses a definite threat to developers considering any type of development, especially a transit-oriented development.

# San Diego

*Meagan Booth and Shabnam Sifat Ara Khan*

San Diego is located on the West Coast of the United States and sits on the border of Mexico. It is the southernmost city in California and is home to approximately 1.3 million people. With a deep ocean harbor, San Diego has always been known as an important trading post. Additionally, the warm waters of the Pacific Ocean make the city a destination location for tourists. Although years of development has centered on Broadway, the vibrant Gaslamp District has also made a strong comeback with further redevelopment. San Diego is evolving and some historical areas shape the city as it is today, such as beautiful Balboa Park.

In recent years, there has been an innovative focus on Transit Oriented Development (TOD) in San Diego and in other major cities throughout the United States. The focus encompasses compact communities centered on light rail systems. Some explanations for the trend include widespread traffic congestion, urban sprawl, walkability and the human desire for a higher quality of life. This chapter will discuss our research in the San Diego Area and how urban design and the built environment play a role in travel behavior. We will begin with a brief history and background of transit in the San Diego Area followed by presentation of our selected stations and profiles. We will next discuss the features we observed that positively or negatively impact TOD at our stations. In conclusion, we will provide our observed recommendations including some ideas from a local planner in the area.

The transit system in San Diego is very much centered on how the city developed. The first notable road, Warner’s Pass, was declared a public road in 1854. The road served as a main road between San Diego and the Colorado River. Soon after, shorter routes were developed and that are used by stagecoaches. Further development occurs when the first electric street lights are installed in 1887. The transcontinental railroad reaches San Diego in November 1885. The railroad leads to a population boom and the Santé Fe Station opens downtown. San Diego Street Car Company begins service in 1886 with an open air street car which expands the system to 5 lines, with 6 cars and 20 horses.

The population boom begins the demand for public transportation and cable cars begin operating in San Diego in 1890. They are called, “Palaces on Wheels” and are trimmed with rare wood and stain glass windows. These streetcars are still highlighted as a tourist attraction to tour the city. At the time the cars travel 8-10 miles per hour. In 1892, J.D Spreckels purchases the San Diego Street Car Company, Park Belt Line, San Diego Cable Car Company, Citizens Traction Company and O.B Railroad. He decides to overhaul the infrastructure of the current transit system and transition to electronically powered vehicles. The process includes installing new double tracks, overhead wiring, building a power plant and purchasing new cars. The system contributed to the development of today’s Mission Hill Suburb. Spreckels continues to expand the system to the entrance of Balboa Park with 101 new cars. The original Santé Fe Station is demolished and renovated to make way for the 21st Century Amtrak, Coaster and San Diego Trolley Station. Unfortunately, Spreckels was not untouchable and World War 1 forces him to discontinue service on several rail lines.

In 1922, the first motor bus goes into service between National City and Chula Vista. By the 1930’s, buses begin to replace street cars and 222 buses are added to the fleet. The Great Depression affects ridership but in the 1940s, WW2 shows a speedy recovery with a 600 percent boost in ridership.

For the first time women are hired to drive transit vehicles. The buses run as quickly as possible and the rail lines are ripped out to make more room for buses. Only three street car lines remain in operation by 1947. In 1949 buses parade down Broadway marking San Diego is the first Californian city to convert to an all bus transit system. It will be three decades before rail systems are seen in San Diego again.

Over the next 20 years, the city acquires ownership of the transit system. Furthermore tourism is boosted with Sea World opening in Mission Bay Park. The transit system carries passengers on 23 routes with 150 buses. By 1977, the San Diego Transit System carries over 30 million passengers on 44 routes with a fleet of 350 buses. In 1981, San Diego Trolley is formed with 14 vehicles on a 15.9 mile primary single track called the South Line. In 1984, ground breaks on the east extension to 12th and Imperial which is now named the Orange Line. In 1985 the City of San Diego gives ownership of the transit system to MTDB which changes to MTS (Metropolitan Transit System). Lastly, in 2005 the 5.6 mile extension opens closing the gap between Mission Valley and Santee.

MTS is currently responsible for long-range planning, financial programming, project development and construction of San Diego’s transportation system. MTS shares assets with San Diego Trolley Inc., (SDTI), San Diego Transit Corporation, (SDTC) and the San Diego & Arizona Eastern Railway Company (SD&AE). This encompasses 108 miles of track and right of way. They service approximately three million people in San Diego County. There are currently four lines (Blue, Orange, Green and Silver) with 53 stations and 102.6 miles of rail. There are 93 fixed bus routes. Their operating budget is approximately 243 million dollars and 94 million dollars comes from fares. MTS estimates there are 88 million annual passenger trips or 285,000 trips each weekday. They make service adjustments three times a year.

## The Stations

The findings from the Hazard Center Station were similar to our expectations for a suburban station. The station did not have a high sense of enclosure (1.98) and a low transparency (2.66) score. This is due to the lack of surrounding building height mostly. Many of the surveyed street segments had low building height with an average of five stories. The landscaping and public art make many of the streets memorable in this area. The station is also close to many retail and shopping opportunities. Many other street segments were filled with contemporarily designed condominiums and is a unique residential neighborhood setting. Therefore, the station still scores higher in terms of complexity (6.32) and human scale (3.46). These features also score higher than the national average, which are 4.73 and 2.64 for complexity and human scale respectively. Finally, T-test shows significant difference in all the design measures except for transparency when compared to national average.

Hazard Center Station scores the low in the D variable categories excluding entropy and block size. The number of people living in this station is slightly over 2,000 per square mile and has approximately 1,861 houses per square mile for their accommodation. Though the station has a decent number of employment opportunities per square mile, at 17,090 jobs/square mile, it has the least job population balance of only 0.0903. This could be explained in terms of the large block size of this station. The average block size for this station is .0206 mile and has only 60 intersection each mile.

Hazard Center Station has the lowest walk mode share (less than 4%), typical of a suburban station. It also shows the poorest transit mode share, which is about 3%. The bigger block size from our D variables analysis could explain the lowest mode split. Though people own only two vehicles per household, at least 8% of people were found to drive to the station and 5% were found to drive from the station. The last mile trip was found to be pretty decent at over 50% coming to the station and 47% for going from the station.

Hazard Center Station was our suburban station. In looking at the survey results for Neighborhood Satisfaction, we noticed although the station is away from the downtown area there is a still a concern about safety. There were high priced single family units and condominiums, nevertheless, survey respondents ranked the quality of the housing units lower than the national average. Although respondents reported a concern with safety they ranked “Low Level of Crime” higher than the National Average. Walkability, Access to Destinations and Attractiveness rated high at this station. This station displayed an array of beautiful planters and landscaping features. Although some of the street segments acted more as corridors, respondents still rated Walkability higher than the National Average.

Transit Service Satisfaction results show that there was a low satisfaction with Parking Availability. The interesting onsite observation is that there is 1000 Park and Ride lot spaces located below Hazard Center Station which is accessible from the back of the building adjacent to the Trolley Station. The Parking allows for direct access to the station. Survey Participants were also satisfied with Frequency, Transit Fare and did not feel the trains were overcrowded.

Civic Center Station scored the highest among the three stations in all the design quality measurements excluding transparency. The imageability score was 5.87 for this station, compared to 4.02 and 5.63 for City College and Hazard Center station respectively. Among the five design qualities, complexity ranked the highest for this station with a value 6.42 followed by 5.87 for the imageability and 3.65 for human scale. The scores for enclosure and transparency scored below four. This refers to the great quality of the built environment surrounding the station. This is supported by our observations since we found most of the streets offering some visual cue and landscaping elements. Being an urban station, it also benefits from the enclosing effects from the high-rise buildings and numerous ground floor retail. The street windows add to the overall human scale quality. Complexity comes from the diverging texture of the retail stores, dining options and ground floor shopping opportunities. In fact, all these built environment characteristics for this station are found to score higher than the national average.

Civic Center has the highest population density among the three stations which 25,560 person per square mile. It is almost 12 times higher than the population density of our suburban station, Hazard Center Station, which has slightly lower than 2,000 person per square mile. To accommodate this huge population density they have housing density (about 15,000 per square mile) higher than the two oth-er stations. The employment density data supports the findings above including densities, population and housing density. Civic Center has 59,090 jobs per square mile which accounts for a higher entropy (0.80) than the other urban station, City College Station (0.77). City College Station has the smallest blocks among our three stations. The average block size of this station was 0.0042 mile and the highest intersection density which is 255 intersection per mile.

The station is served by both Orange and Blue line, connecting the old town until Santee with the former and the beach area in San Ysidro with the latter one. The Orange line overlaps with the Blue line to service the downtown San Diego and the Orange line stops at El Cajon. Civic Center is also supported by connecting bus routes and since it is very close to the Santa Fe Depot During weekdays, the Orange Line begins running from Civic Center Station at 4:40 am running until 1:36 in the morning. The service is almost same during weekends except service ends at 12:06 am. Within a half mile buffer of the station, the walk mode share was about 20 percent which is the highest among the three stations. The station has also the highest transit mode share of about 11 percent and the average household vehicle ownership is 3. However, from our survey we found that only 10% people drive for their last mile trip. In fact, 52% walked to the station while 42% walked from the station on their way back in this station. The highest walk share was visible during our visit to the station.

The built environment surrounding the City College Station scored the lowest in terms of imageability (4.02), human scale (3.09) and complexity (5.76) among the three stations. The highest scores for these design measures were 5.87, 3.65 and 6.42 respectively. Among the five design measures, Civic Center Station was found to score the lowest in enclosure, which is only 2.83. This is due to the proportion of the sky one can see across and ahead of the street in the environment. Though few street segments have tall buildings, the majority of the street segments lacked street wall or active uses. That’s why adjusting for T-tests, only human scale (3.09) and complexity (5.76 were significantly different than the national average.

City College is our other urban station which measured favorably in population, housing, employment, and intersection density. The surrounding area has small block size to support a transit oriented development. It has the second highest population, housing, employment and intersection density, which are 16,870 per square mile, 8,152 per square mile, 259,000 jobs per square mile and 212 intersection per square mile. However, it has the lowest entropy (0.77) among the three stations. The lower entropy can be explained in terms of the lower employment density which is half the number of the employment density of the Civic Center Station. Low employment density could be due to the nearby college campus and rooming accommodations.

City College Station is also served by both Orange and Blue line. Similar to the Civic Center Station, it also has similar schedule and service hours. However, the walk mode share was slightly lower than the Civic Center Station, which is 16 percentage for walkshare and 10 percentage for transit mode share. People around the station own approximately 2 vehicles per household. The walk mode share and transit mode share were found to be even higher for this station from our survey. For the last minute trip, the walk mode shares were 60% for coming to the station and was 50% for going from the station.

At City College Station we discovered that a majority of tenants rent due to high cost of living in the area. Many respondents were 18-25 years of age. There was an even number of diversity between males and females. The surveys also indicated although a majority of respondents have multiple vehicles per household many respondents still chose to use transit. Based on the time of day that we conducted our surveys a majority of respondents were heading home. It is impressive that a majority of respondents were satisfied with the proximity of the station to their destination of choice.

**Table 13. Hazard Station Characteristics**

|  |  |  |
| --- | --- | --- |
|  | Station Averages | National Averages |
| **D Variables** |  |  |
| Population Density (sq.mile) | 1,996 | 10,992 |
| Housing density (sq.mile) | 1,861 |  |
| Employment Density (sq.mile) | 17,090 | 29,859 |
| Job population balance | 0.09 | 0.385 |
| Entropy | 0.89 | 0.828 |
| Average Block Size (sq.mile) | 0.02 | 0.631 |
| Intersection Density (sq.mile) | 60 | 356.2 |
| Destination accessibility (within 45 minute drive) | 267,256 |  |
| **Urban Design** | | |
| Imeagability | 5.63\* | 3.54 |
| Enclosure | 1.98\* | 4.10 |
| Human Scale | 3.46\* | 2.64 |
| Transparency | 2.66 | 3.07 |
| Complexity | 6.32\* | 4.73 |

\* *Indicates a statistically significant difference*

**Table 14. Civic Center Station Characteristics**

|  |  |  |
| --- | --- | --- |
|  | Station Averages | National Averages |
| **D Variables** |  |  |
| Population Density (sq.mile) | 25,560 | 10,992 |
| Housing density (sq.mile) | 14,296 |  |
| Employment Density (sq.mile) | 59,030 | 29,859 |
| Job population balance | 0.298 | 0.385 |
| Entropy | 0.80 | 0.828 |
| Average Block Size (sq.mile) | 0.004 | 0.631 |
| Intersection Density (sq.mile) | 255 | 356.2 |
| Destination accessibility (within 45 minute drive) | 260,004 |  |
| **Urban Design** | | |
| Imeagability | 5.87\* | 3.54 |
| Enclosure | 3.47 | 4.10 |
| Human Scale | 3.65\* | 2.64 |
| Transparency | 3.20 | 3.07 |
| Complexity | 6.42 | 4.73 |

\* *Indicates a statistically significant difference*

**Table 15. City College Station Characteristics**

|  |  |  |
| --- | --- | --- |
|  | Station Averages | National Averages |
| **D Variables** |  |  |
| Population Density (sq.mile) | 16,870 | 10,992 |
| Housing density (sq.mile) | 8,152 |  |
| Employment Density (sq.mile) | 25,900 | 29,859 |
| Job population balance | 0.41 | 0.385 |
| Entropy | 0.77 | 0.828 |
| Average Block Size (sq.mile) | 0.004 | 0.631 |
| Intersection Density (sq.mile) | 212 | 356.2 |
| Destination accessibility (within 45 minute drive) | 262,820 |  |
| **Urban Design** | | |
| Imeagability | 4.02 | 3.54 |
| Enclosure | 2.83 | 4.10 |
| Human Scale | .09\* | 2.64 |
| Transparency | 3.25 | 3.07 |
| Complexity | 5.76\* | 4.73 |

\* *Indicates a statistically significant difference*

## Themes

**Homelessness: Safety and Public Health**

Since San Diego possesses some of the most pleasant weather conditions, therefore, people all over the country find their home on the street of the city. San Diego ranks 5th in the nation among cities with homeless people. The city and many organizations work together to try and support the homeless people to obtain a higher quality of life. Such programs include emergency shelters, transitional housing, safe havens, social programs and counseling.

In order for Transit Oriented Developments to be successful in San Diego, more attention should be placed on visitor and resident safety. From our interview and bystanders on the street, the homeless population causes concern. Our data also indicates that all three stations ranked lower in satisfaction from safety then the National Average with the lowest satisfaction ratings at Hazard Center (3.17) and Civic Center Station (3.29). This also is also consistently true about respondent’s feelings about crime.

Although there are MTS Security Officers on the platforms at Civic Center Station and City College Station, there were few in proportion to the capacity of people the station. Moreover, the officers seemed consumed by checking for the proof of payment so they didn’t really have time to investigate the activity of the homeless. The fact that there are not adequate public facilities around the station is a sanitation issue and local businesses have been accustomed to keeping the homeless out and locking any public restroom. As we walked along the street, we came human feces and liter. We also saw homeless camped throughout the day.

**Nightlife and Entertainment Opportunities**

The streets in downtown San Diego promote a rich nightlife culture. The vibrant sound and lighting of the bars make the area full of life and excitement. Such characteristics generate diversity by inviting people of different colors, ages, professions and culture. Some design characteristics that add to the character include the variety of buildings, beautiful landscape design, street level windows, vibrant signs, colorful public arts, historical buildings and presence of people on the street. As we walked along we were constantly impressed the many colors of the buildings, texture from the landscapes, and smell from the outdoor dining. Downtown San Diego offers an array of dining options. While walking we found Indian, Chinese, Japanese, Mexican and American dining places. of the multi-rise buildings. Each street has at a few multi-rise buildings that produce a generous vertical density in these areas.

The bars also makes the Gaslamp District dynamic. The restaurants offer a place to eat but also add to the complexity of street. This can be seen in the interior and exterior design. Most business feature multiple awnings and porches, which are extremely welcoming features. These restaurants are not only rich in outdoor dining, their inner rooms are visible and approachable from outside with their glass walls, open doors and street level windows. A pedestrian can easily see what choices are inside from far ahead. The entrances of these places are open during many hours during the day. The restaurants and the other retail services present vibrant and human scale signage. Walking down the street a person can easily read the signs. We saw very few signs that are auto-oriented.

The street segments also offer pedestrians an array of furniture ranging from utility poles, trash can, street lights, bus stand poles, parking meters, street banner, street trees, bike pads, bollards, bus stops, and so forth. This is supported by our ratings. At Civic Center Station respondents were most satisfied with Attractiveness, Street Lighting and Walkability. The retail spaces, dining options, commercial activities make the streets an ongoing activity centers.

All the buildings face the streets and are very close to the sidewalk (within 3-4 feet). There were few parking lots in our study area. The multirise buildings articulates to the street level at ground floors through their street level doors, vast glass walls and windows and various textures. Such design qualities are essentials to foster active usage because as one walks along them they can identify a progression of the street and are drawn to the immediate area. The nightlife is definitely a positive attribute of all of our stations.

**Mixed-use development and further integration**

The City of San Diego reports that there are policies established to set the framework for growth and new development to contain a mixture of land uses. This was validated by our City Planner. Creating low income housing is a primary focus of the City Housing Commission. Through our observations we noticed that residential and commercial uses existed with in our buffer around the stations. Mixed use refers to the combining of compatible commercial, retail, and/or office uses in the same building (vertical mixed use) or on the same site (horizontal mixed use) as residential. This includes higher density residential development to serve many market segments, along with a mix of commercial, retail, civic, and recreational to serve the overall community.

One observation we noticed right away is that the land uses are often times still separated for example there are large scale apartment complexes adjacent to commercial buildings. This was more observable at our Hazard Center Station and City College Station. From our interview we discovered that an approved multi-family development was planned at Hazard Center but the plan fell through and there has been no further discussion. However, our planner reports that Hazard Center does have the one of the highest ridership rates in the city. We would recommend integrating them both vertically and horizontally so they are fine-grain mixed. This would be a recommended for new developments and any extensions or in-fills. Our data also indicates the need for “low income housing” as a majority of respondents are renting then owning their homes. From our interview, we discussed the issue of public verses private ownership and the issue that is raised regarding designing mixed use developments. Most of the time the reason for not integrating uses is affordability without any assistance.

**Built Environment Promotes Accessibility and Tourism**

Through our surveys and discussions, we were told time and again that residents are satisfied with the transit system and the way it allows them accessibility to all areas as of the city. This is an important feature of Transit-Oriented Development as people want to work and play where they live. This also is commendable for San Diego as a tourist location. The built environment that allows accessibility contributes positively to a person’s physical and mental wellbeing. Using transit allows for an alternative to owning a car and is also attractive when transit allows for regional accessibility for residents and tourists.

The aforementioned features and design qualities of our street segments interplay to create a range of activities on these areas. The small block size and presences of multi-storied buildings that generate vertical density and activity centers generate a really compact development. People can live, play, and work on these areas and they can walk or bike to their places of destination without having to rely on their automobiles. We encountered huge number of pedestrians all throughout our study. Hazard Center Station however had some street segments that had high speed traffic and was less pedestrian friendly, the effect is reversed with the access of public transit. The city light rails, trolley, and the bus services take the residents to everywhere starting from downtown, to recreation spot such as indoor and outdoor stadiums and to tourist such as the beach, park or zoo.

The compact development patterns that orient the city's transit facilities highly facilitate the access to transit to its residents. The huge number of passengers on our platforms allude the extremely positive response of the residents towards transit facilities. When asked a significant number of people informed us that they relied on non-automobile commute to the transit stations. Our study areas featured bike pads and green bike sharing facilities almost everywhere. Such facilities promote cycling. Furthermore, the bus services reach areas people need to travel. The hours of operations, frequency and reliable timing of the transit services again highly supportive of the users. Further, the city's parking facilities are expensive and works to discourage people to rely on cars.

**Landscaping, Streetscape and Walkability**

This concept is very true in San Diego where we found the well maintained landscaping adds to the built environment and promotion of Transit Oriented Development. Just as the restaurants, art and shops complement the neighborhood we believe the greenspaces also adds to the vibrancy of the streetscape. San Diego has beautiful weather all year long which encourages people to travel by foot especially to nearby Balboa Park not to mention the nearby beaches. It’s hard to miss the colors of all the flowers and all the palm trees. The focus on online shopping also shows that consumers are demanding greater public spaces, walkability, diverse culture and activities. City Creek in Salt Lake City is an example of an investment in Landscape Infrastructure and creating this type of holistic experience.

Some may say that San Diego is still auto oriented but the beauty of the landscaping is undeniable and should be appreciated from street level. The colors of the street tress, plants and flowers stand out on the street level which adds complexity and texture. The trees provide shade and act as street buffer. In the Gaslamp district the trees are strong with lights at night and this again adds to the complexity of the street. The landscaping is strength for Transit Oriented Development in and around our stations. Our data also shows that Walkability is very important in Neighborhood Satisfaction rating higher than the National Average at City College and Hazard Center Stations.

# Washington D.C.

*Miranda Carter and Jenna Simkins*

The Washington, DC metro area is a leader in fostering and planning for transit oriented development. According to Cervero (2004), the Metrorail system was planned and built with the intention of channeling future development (pg. 229). It was the first attempt after World War II, in the United States, to use transportation improvements to influence land use patterns. Counties, the district, and the Washington Metropolitan Area Transit Authority (WMATA) each engaged in planning efforts years before Metrorail was complete. In addition, WMATA early on created a real estate department and policies to foster public-private partnerships, aggressively pursuing joint development opportunities.

Based upon the 2010 census, the Washington-Arlington-Alexandria Metro Area’s population was almost six million, with about 953 people per square mile (CensusReporter). The median age was 36.3, which is slightly less than the United States as a whole. The percentage of people living in poverty was 8.5. 66% of people drove to work, 14% took public transit, 10% carpooled, 5% worked at home, and 3% walked. The average travel time to work was 34 minutes. More individuals have a high school diploma (90.5%) or college degree (48.7%) compared to the United States average.

The metrorail system, which serves parts of Washington DC, Arlington, Montgomery, Prince George and Fairfax County, is a hybrid of inner city subways and above ground, suburban commuter rail (Fig. 1). As is the case for most transit planning, politics played a role in its design (Schrag 2001). In 1967, the newly formed Washington Metropolitan Area Transit Authority (WMATA) needed voters, urban and suburban, to approve the proposed system plan. However, they also needed a cost-effective transit system, one with enough riders to pay off construction costs. In the end, each of the surrounding counties received one or multiple rail lines. While there are single lines out in the lower density suburbs, they converge and double or triple up within the city, providing more frequent service where it is needed. WMATA is “the second largest public transit operator in the United States, carrying over 1 million customers a day on bus and rail,” (pg. 229, Cervero et al. 2004). Unlike most agencies, WMATA has no regular stream of public monies and must negotiate with counties, cities and the federal government for funds.

Many of the MetroRail stations with the highest scores for the D variables were in the older parts of DC. We did not choose these sites because they developed when walking or streetcars were the dominant mode of transportation. The purpose of our study was to investigate how walkable and transit friendly new, consciously planned, developments were. We wanted a mix of suburban and urban TODs, and a good geographic/political sampling by choosing one from Virginia, one from Maryland, and one from DC (Fig. 2). Our initial selection was Crystal City, NoMa, and Bethesda. Based upon the recommendations of a member of the WMATA Real Estate department, we replaced Crystal City with Clarendon. NoMa is urban site undergoing redevelopment, as it was formerly comprised of mostly railyards, abandoned warehouses and empty lots. Bethesda is a frequently cited example of successful TOD. Clarendon is part of the famous Ballston-Rosslyn corridor, which has five planned TODs in a row on a rail line.

## The Stations

Bethesda Metro Station is located in Montgomery County, Maryland. Like Arlington County, Montgomery County began planning for transit oriented development years before Metrorail would be complete. In 1970, the County updated downtown master plans, making the Central Business District cover a smaller area in order to further concentrate and densify new development (pg. 251, Cervero 2004). Bethesda had in the past experienced a great deal of land development and economic growth, but citizens were dismayed by the lack of any coherence in urban design. Therefore, the master plan was also changed to include design standards, with more power given to County planners to approve or disapprove site proposals (pg. 252). A buffer zone was added, to make the transition between downtown and more residential areas less sudden. The County also promoted private-public partnerships.

Directly above the station, WMATA began a joint development project in 1981 (interview). The development was a success, adding “400,000 square feet of office space, a 380-room Hyatt Hotel, and 60,000 square feet of retail space” (pg. 26, Transit-Oriented Development in the United States). However, the modernist towers can be overwhelming. WMATA is currently planning the redevelopment of parts of the site to make it more inviting to pedestrians. Bethesda remains an exemplar of transit oriented development to the present day. The newer 13.5 acre Bethesda Row development, a mix of office, retail and restaurants, with some residential, has nearly full occupancy rates (pg 252, Cervero et al. 2004). From our personal experience, and based upon our randomly selected street segments, the quality of the urban environment varied. While some streets were pedestrian friendly, others lacked basic amenities like sidewalks and active uses. There were multiple construction projects underway.

Bethesda’s population density, at 11,020 people per square mile, is nearly equal to the national average. The employment density is higher than average, with 45,890 jobs per square mile compared to the national average of about 30,000. The job population balance, .22, is the lowest among the three DC metro area sites, and is lower than the national average of .38. The mix of land uses is high at .88, but only slightly higher than the national average of .82. At .0076 acres, block sizes were comparable to other DC sites, but much smaller than the national average of .63 (the standard deviation was 1.23). Bethesda had roughly half the number of intersections per acre compared to the national average and Clarendon Station.

The U shaped MetroRail Red Line services Bethesda station, connecting the city to downtown DC and the suburbs north. On weekdays, the first train is at 5:17 am, the last at 12:23 am. On Fridays and Saturdays, service begins 2 hours later than weekdays and runs 3 hours later into the early morning. Peak time headways are at 3 minutes, with off peak and evening service at 12 minutes. Late night headways are 20 minutes. Within a half mile buffer of the station, the walk mode share for work trips was 12.40 percent, and transit mode share was 29.86 percent. Households owned an average of 0.94 vehicles.

After performing T-tests, only the urban design quality of Human Scale was significantly different from the national average. Scored at 3.75, it was higher than the national average of 2.64. Enclosure was almost statistically significant, and was only 2.66 compared to the national average of 4.10, which had a standard deviation of 14.51. At Bethesda Station, at 54 percent, there were slightly more men than women who answered the survey. Respondents were young, with 42 percent between 18 and 25 years of age, 26 percent between 26 and 35. In contrast, only 10 percent were between 50 and 65. Most respondents, 78 percent, rent their housing (this finding may correlate with age). The average number of vehicles owned/available was 1.42 cars, and over 60 percent of people said they could have drove instead of taking transit.

For neighborhood satisfaction, the highest scoring categories for Bethesda were Safety, Low Crime and Walkability (Fig. 4). At an average rating of 2.88, Housing Prices received the lowest ranking, and was similar to the national average at 3.08. The greatest difference between the national average and Bethesda survey takers’ responses were for Low Crime (3.66 vs. 4.55) and High Quality Housing Units (3.64 vs. 4.37). For Transit Service Satisfaction, the scores roughly matched the national averages, with the rating for the service overall being the highest (Fig. 5). Respondents were least satisfied with fares, and rated it lower than the national average (2.87 vs. 3.38). Most people came from home, and most were going somewhere for recreational purposes. 46percent percent of people walked to the station and 72 percent of people planned to walk to their destination (Fig. 6).

Clarendon Metro Station is part of the Ballston-Rosslyn corridor, where five stations in a row are TODs. In the late 1950s and early 1960s, the corridor had an auto oriented built environment which was beginning to degrade, and the area was economically stagnant. Planners, County officials, and private citizens viewed Metrorail as a way to revitalize the area, and began planning for TODs in the 1960s. According to the Arlington County website, officials and planners convinced WMATA to build the rail line underground, rather than in the median of a nearby freeway. Two above ground arterials mirror the rail line, which enables bus service and car drivers to easily reach the TODs.

The County website also states that the corridor is an example of smart growth, as the large demand for office space in the 1960s was directed and concentrated around these five stations. Calling the plan a “bull’s eye approach,” densities and height limits are greatest near the stations, and taper down with distance. The County created “general land use and station area plans” (pg. 236, Cervero 2004). They also formulated and implemented strategies, like incentive zoning, to achieve desired densities and urban form patterns. Each station was planned to be unique and retain some its previous character, and Clarendon was labelled as an urban village. Over time, the corridor has undergone a great deal of growth in office space, retail and housing.

The Ballston-Rosslyn corridor is also an example of how to maintain pedestrian friendly places over time. Cervero et al. (2004) argue that the corridor has remained vibrant because Arlington County stuck to their vision but also continually updated their plans, and brought everyday citizens into the planning process (pg. 236-238). From our personal experience, Clarendon was a mix of old and new, with big chains like Cheesecake Factory within a block of local stores. Some of the apartments buildings seemed recently built, and another building near the station was undergoing renovations.

At 13,100 people per square mile, Clarendon has the highest population density of our three sites and is above the national average. Employment density is only about a third of the national average. Both of these figures confirm perceptions that Clarendon is a bedroom community for DC. Still the job population balance was far above the national average at .81. The entropy score is close to the other stations and the national average. Average block size were much smaller than the national average. Out of the three DC metro area stations, Clarendon had the highest number of intersections per square mile, but was still below the national average.

Within a half mile buffer from the station, about 9 percent of people walk to work, and 32 percent take transit. Households on average own 1.37 vehicles.

The Orange and Silver lines service Clarendon Station. The first train is at 5:29 am, and the last is at 12:17 am on weekdays. On Fridays and Saturdays, service begins 2 hours later than weekdays and runs 3 hours later into the early morning. During the peak, each line operates at 6 minute headways, whereas during off peak times and in the evening, trains arrive every 12 minutes. Late at night, after 9:30 pm, trains are 20 minutes apart.

After performing T-tests, only human scale and complexity scores were significantly different than the national average. At 3.75, human scale ranked higher than the national average of 2.64. At 6.04, complexity was higher as well, but had a high standard deviation of 2.28.

Like Bethesda, most of the survey respondents at Clarendon were young: about 68 percent were between the ages of 18 and 35. Most of the respondents identified as male (51 percent), and one survey taker left it blank. 71 percent were renters. 53 percent could have driven rather than taking transit. The average number of cars available to respondents was 1.20.

When asked about the area surrounding the station, respondents at Clarendon were most satisfied with the attractiveness of the neighborhood, the average being 4.56 out of 5 (Fig. 8). The national average was lower at 3.84. Survey takers were least satisfied with housing prices (2.83 average score), and many commented that housing was too expensive and that some form of rent control was needed. It was the only category in which Clarendon received a lower score than the national average. When asked about their satisfaction with the transit service, respondents ranked the MetroRail close to, but below, the national average for most characteristics (Fig. 9). At an average score of 3.08, respondents were least satisfied with fares, and, at 3.66, were most satisfied with the overall service.

49 percent of survey takers came to the metro station from their home, followed by 36 percent whose starting point for their trip was their workplace (Fig. 10). There was a more even distribution among destinations. 35 percent were heading home, about 29 percent were going to engage in recreation activities, and 12 percent planned on going shopping. 69 percent of respondents walked to the station, 23 percent used transit, and 8 percent drove.

In November 2004, The NoMa-Gallaudet U Metro Station became the 84th station added to WMATA’s Metro system. Originally called New York Avenue-Florida Avenue-Gallaudet U Metro Station, the station was renamed NoMa-Gallaudet U in 2011 in anticipation of service changes and to be more identifiable on the updated Metro Map with its 19-character limit for station names. NoMa-Gallaudet U was a unique project for its time. It was WMATA’s first “in-fill” station, being built on an existing line between two existing stations (Union Station and Rhode Island Avenue). It was also the result of a public-private partnership between private landowners, the District of Columbia government, and the federal government.

Population density within a quarter-mile of NoMa-Gallaudet U is 9,631 per square mile. The employment density is 10,440 jobs per square mile. The block sizes around NoMa-Gallaudet U were the largest of our three stations. Still, entropy was high (0.78). The percentage of people walking to work was the highest of our three choices at 16.71%, as was the percentage taking transit to work at 36.16%. The job per population balance was fairly high at 0.64.

NoMa-Gallaudet is exclusively served by the Metro Red Line, which runs between Shady Grove and Glenmont. Monday through Friday, the trains run from approximately 5:30 AM until midnight, with weekend service running two hours later in the mornings and three hours later in the evenings. Peak-hour WMATA headways are 6 minutes, off-peak headways are 12 minutes, and late-night service headways are 20 minutes. While there is no vehicle parking at the station, there is bike parking available, as well as car sharing. Bus routes 90, 92, 93, and X3 service the NoMa-Gallaudet U station.

Adjusting for T-tests, only imagebility (2.99) and complexity (5.31) were significantly different than the national average. Enclosure fared the worst around NoMa-Gallaudet U, at -1.48, compared to the national average of 4.10. Human scale was 2.74, compared to 2.64 nationally. Transparency was 2.45, compared to 3.07 nationally. About 41 percent of survey takers at NoMa were women, and about 56 percent were men. About 61 percent of respondents were renters, and 23 percent owned their housing. Like the other two stations, respondents were young: 34 percent were between 18 and 25, and 41 percent were between 26 and 35. Unlike the other stations, a majority of people, 52 percent, could not have driven instead of taking transit, compared to 41 percent who could.

For neighborhood satisfaction, respondents ranked NoMa below the national average for every category (Fig. 12). They were most satisfied with how easy it was to walk around (3.85), and the score almost matched the national average (3.98). They were least satisfied with housing prices, however there were also gaps below the national average for neighbor interaction, low crime, and safety. Similarly, for transit service satisfaction, respondents ranked NoMa below the national average for every category (Fig. 13). The greatest gap was for transit service reliability, with NoMa at 2.88 and the national average at 3.65. The highest ranked characteristic was operating hours, while the lowest was transit fares. About 77 percent of survey takers walked to the station, and about 18 percent took transit. A smaller amount, 69 percent, planned on walking to their final destination, while about 18 percent would take transit, and 11 percent said they would drive. Most people were coming from work (53 percent), and most people’s destination was home (66 percent) (Fig. 14).

**Table 16. Bethesda Station Characteristics**

|  |  |  |
| --- | --- | --- |
|  | Station Averages | National Averages |
| **D Variables** |  |  |
| Population Density (sq.mile) | 11,020 | 10,992 |
| Employment Density (sq.mile) | 45,890 | 29,859 |
| Job population balance | 0.22 | 0.385 |
| Entropy | 0.88 | 0.828 |
| Average Block Size (sq.mile) | 0.007 | 0.631 |
| Intersection Density (sq.mile) | 192.42 | 356.2 |
| **Urban Design** | | |
| Imeagability | 3.24 | 3.54 |
| Enclosure | 2.66 | 4.10 |
| Human Scale | 3.74\* | 2.64 |
| Transparency | 2.69 | 3.07 |
| Complexity | 5.18 | 4.73 |

\* *Indicates a statistically significant difference*

**Table 16. Clarendon Station Characteristics**

|  |  |  |
| --- | --- | --- |
|  | Station Averages | National Averages |
| **D Variables** |  |  |
| Population Density (sq.mile) | 13,100 | 10,992 |
| Employment Density (sq.mile) | 9,749 | 29,859 |
| Job population balance | 0.81 | 0.385 |
| Entropy | 0.85 | 0.828 |
| Average Block Size (sq.mile) | 0.006 | 0.631 |
| Intersection Density (sq.mile) | 302.25 | 356.2 |
| **Urban Design** | | |
| Imeagability | 3.76 | 3.54 |
| Enclosure | 2.72 | 4.10 |
| Human Scale | 3.76\* | 2.64 |
| Transparency | 3.09 | 3.07 |
| Complexity | 6.04\* | 4.73 |

\* *Indicates a statistically significant difference*

**Table 16. NOMA-Galudet Station Characteristics**

|  |  |  |
| --- | --- | --- |
|  | Station Averages | National Averages |
| **D Variables** |  |  |
| Population Density (sq.mile) | 9,631 | 10,992 |
| Employment Density (sq.mile) | 10,440 | 29,859 |
| Job population balance | 0.64 | 0.385 |
| Entropy | 0.79 | 0.828 |
| Average Block Size (sq.mile) | 0.008 | 0.631 |
| Intersection Density (sq.mile) | 184.42 | 356.2 |
| **Urban Design** | | |
| Imeagability | 2.99\* | 3.54 |
| Enclosure | -1.48 | 4.10 |
| Human Scale | 2.74 | 2.64 |
| Transparency | 2.45 | 3.07 |
| Complexity | 5.31\* | 4.73 |

\* *Indicates a statistically significant difference*

## Themes

**Cost of Living**

When asked about housing prices, survey respondents rated all three of the DC metro area stations below the national average. However, it was only significantly different from the national average at NoMa station. Still, in the free form answer section, many people noted that housing prices were high, along with other fundamental needs. At Bethesda Station, in response to the question “What do you like least about your neighborhood?”, three out of five respondents wrote that the area was “expensive” and “prices and rent.” One person wrote “snobs, lol.” High prices did not bother all respondents, as another person wrote that “income level, amenities” were what they liked most about the area. At Clarendon, seven out of eleven responses to the same question mentioned “expensive” or “rent prices.” Three out of eight, in response to a question about the cons of living near a station, noted that rent prices, and/or the cost of living, increases. Strangely enough, none of the respondents in NoMa explicitly noted a high cost of living. The homeless population, trash, and crime were more pressing concerns.

An employee within the WMATA real estate department noted housing prices within the Ballston-Rosslyn corridor (which includes Clarendon) were too expensive for most millennials to afford. The graph below shows Center for Transit Oriented Development data for the three stations; the data may not reflect recent changes, particularly at NoMa (Fig. 16).

Montgomery County was a pioneer in implementing incentive zoning in the 1970s, which allows developers to build at higher densities if they include affordable units. While the program has been successful, it does have limitations, as the area is now mostly built out. Arlington implemented a similar program later on, with some success. Washington, DC has a mix of policies, which include incentive zoning, rent control, and subsidizing federal voucher programs. Critics argue that the current affordable housing policy, due to set income requirements, helps only the most well off among the poor. Funds from the federal government are also decreasing, leaving many programs weaker and less effectual than before.

**Longevity**

Two of our sites, Bethesda and Clarendon stations, are among the oldest transit oriented developments in the United States. Investigating how each has remained a vibrant urban place over the past forty years may provide other regions with the necessary tools and strategies to foster and maintain TODs for the long term. As discussed earlier, Montgomery County and Arlington County began planning for land use changes near the metroRail stops years in advance of the station openings. Following “textbook planning principles,” Arlington had many essential elements for successful TODs, such as a mixture of uses and an appropriate density, in place right from the start (pg. 235, Cervero et al. 2004).

While zoning is a common challenge for TODs, zoning policies by themselves are probably inadequate for long term vitality. Each public entity had a vision for what they wanted their communities to look like, and they articulated it in planning documents. For instance, Arlington County created a general land use plan for the corridor and sector plans for each station. These plans are frequently revised, keeping them relevant by addressing current opportunities and challenges, such as rising housing prices. In addition, in 1989, officials also reviewed their progress toward attaining their goals, to see if their strategies were working.

Both Counties recognized the importance of good urban design in making enticing places. The Clarendon Station sector plan defines different “frontage types” for specific streets, which outlines characteristics like the maximum distance between entrances into buildings, and the percentage of transparency (windows) on the ground floor. While the Bethesda CBD plan is less detailed, it also lists good urban design practices, emphasizing visual coherence as well as interesting streetscapes. The attention to urban form is reflected in the survey results. In Clarendon, attractiveness was the neighborhood characteristic respondents were most satisfied with, and was above the national average.

Public participation in the planning process fostered support for urban form changes. From our interview with WMATA real estate advisors, NIMBYism was never a problem in Arlington County because residents “bought into” the vision. A real estate developer noted that, due to the large number of engaged citizens groups, nothing will be built without public approval (Land Use Transportation Planning class, Guest Lecturer). Similarly, the developer for Bethesda Row listened to public concerns about local businesses being harmed by big chain stores, and responded by fostering a mix, local, regional and national businesses in the development. In short, to creating lasting appeal and value, cities and regions must engage in the difficult process of placemaking.

**Station Accessibility**

How well integrated and connected a station is to the surrounding environment influences where new transit oriented development occurs. Above ground rail lines, due to concerns about safety and efficient transit service and freight movement, can reduce street connectivity, creating a divide between two areas. Infrastructure takes up space where more active land uses could be present. Elevated rail lines are no different, acting as a barrier and negatively affecting the pedestrian environment. NoMa’s new development, which is almost entirely on the west side of the tracks, shows how important transit station access is for attracting willing investors. In addition, how easy or difficult it is to walk to a station has implications for a site’s long term vitality and success.

While the relative ease and appeal of redeveloping abandoned warehouses and empty lots clearly influenced development patterns, station accessibility was another consideration (interview). The Red Line runs along the western side a freight and commuter rail corridor, making the station on the west side of the tracks. Transit riders approaching from the west therefore do not have to go underneath wide overpasses in order to enter the station. The Metropolitan Branch trail also runs alongside the western side of the rails, connecting pedestrians and cyclists to the southern entrance. While the southern entrance is next to a two-lane street which continues west and east, underneath the tracks, the northern entrance is set back from Florida Avenue, a main thoroughfare connecting the two sides, requiring a small amount of backtracking to reach. The sidewalk quality and size along the thoroughfare, a six lane road, are inadequate, and are not setback. Two small streets, one east-west, the other north-south, lead to and meet at the northern entrance.

WMATA, the BID, and the district, are aware of the problem this presents for fostering new development on the east side. WMATA is investigating the possibility of a new station entrance that would increase accessibility from the east side (interview). The BID, with funds from the district for implementation, held a contest for “underpass art parks,” with the goal of making the pedestrian experience more enjoyable.

**Public Places**

Public spaces, such as parks, plazas, and squares, can provide multiple benefits for nearby residents. For those living in cities, a park can be an additional living space, and frequently may be the only outdoor space, other than streets and sidewalks, a person has access to. Plazas and squares may help foster a sense of community, as the space can host events ranging from festivals to political protests and demonstrations.

While public spaces, including plazas, parks, and dog parks, were common in Bethesda and Clarendon (Fig. 21), they were nearly non-existent in the quarter mile buffer around NoMa-Gallaudet Station. We encountered one small park, with cement slabs for seating, and a few trees and grass, on the southeast corner of First St NE and New York Avenue, an extension of the Alcohol Firearms and Tobacco office complex (Fig. 20). As one component of the imageability measurement, the lack of public spaces was reflected in NoMa’s average score of 2.99, which was significantly below the national average.

There are a few possible reasons why there are no public spaces. Some argue that the city failed to plan ahead and buy land before upzoning the area, when it was cheaper. Buying the land now is expensive and difficult. A large park would require a developer to forgo potential profits, as there is little or no land that is not currently being developed or will be soon. There also seems to have been some initial uncertainty as to whether people would live in the area, and at what density. NoMa may have been dominated by office space for government departments and non-profit organizations.

According to one of the people we interviewed, a lack of public spaces may hinder NoMa’s long term viability. Other areas, such as Navy Yard, may be less popular now, but may outshine NoMa due to increased public amenities and sense of place. The NoMa Business Improvement District, and the District of Columbia, recognize the lack of public space as a problem, and are trying to remedy it. In 2014, the District contributed 50 million dollars for purchasing land and building parks. The NoMa Parks Foundation, a non-profit organization, is planning for linear and pocket parks, and investigating multiple sites for a larger park. One potential project is the “NoMa Meander,” a somewhat circuitous pedestrian pathway cutting north-south through four blocks. Another potential park is on land near the tracks that would be difficult or impossible to build upon.

**Pedestrian Environment on Arterials**

Walkable streetscapes are considered an essential part of creating successful transit oriented development. Yet frequently, the pedestrian environment on arterials is overlooked or regarded as a lost cause. While these streets can easily become barriers and dead spaces for those on foot, there are ways to manage them and reduce their negative effects. In Bethesda and Clarendon, arterials, while less pleasant than smaller streets, were still acceptably comfortable for walking. In contrast, a major arterial in NoMa did not even feel particularly safe, let alone inviting. Examining the differences between the stations, based upon our experiences and the urban design measurements, will highlight ways to better integrate arterials with transit oriented development.

Rather than being entirely a hinderance, two arterials, which connect the five TODs of the Ballston Rosslyn corridor above ground, and mirror the MetroRail system below, have partly contributed to their success. Most roads lead to the arterials, facilitating automobile access as well as pedestrians and bus service (pg. 235, Cervero et al. 2004). Bethesda has a similar situation, and planners must balance traffic speeds and volumes with the pedestrian environment. In Clarendon and Bethesda, Wilson Boulevard and Wisconsin Avenue (part of MD-355) were walkable even though they are arterials (Fig. 22). For both, sidewalks are set back from the road, with street trees and street furniture acting as a buffer between the cars and the pedestrians. While less frequent than other streets, safe crossings are not too far apart. Perhaps most importantly, active uses like drug stores, dry cleaners, and restaurants front the streets and form a wall. These qualities are reflected in the urban design measurements: both roads scored above the national average (4.14 and 4.54) on Human Scale, which considers street furniture, sight lines and windows at street level.

Florida Avenue near NoMa-Gallaudet Station lacks many of these qualities. Sidewalks are narrow and directly adjacent to the road, most buildings are setback, and there are few uses which would encourage walking (Fig. 23, 24). Crosswalks are far apart and feel less safe than those in Clarendon and Bethesda. While the Human Scale average score of 2.64 is similar to the national average, it is below the other two DC stations. While surveying streets during the afternoon peak, officers directed traffic at an intersection which had a charter school on one of its corners (Fig. 25). Even though speeds may be slower with traffic congestion, drivers act more aggressively at times, creating a safety concern for children and adults.

Cervero et al. (2004) write that appropriate parking prices, useful transit service, and traffic management has kept Wilson Boulevard walkable. Still, like Florida Avenue, many sections of the arterials along the Ballston Rosslyn corridor could be improved.

**References**

**References:**

Alpert, D. (November 29, 2010). “NoMA has no parks thanks to flawed upzoning”, Greater Greater Washington. Retrieved from: http://greatergreaterwashington.org/post/8313/noma-has-no-parks-thanks-to-flawed-upzoning/

CensusReporter (n.d.). Retrieved from: http://censusreporter.org/profiles/31000US47900-washington-arlington-alexandria-dc-va-md-wv-metro-area/

Cervero, R. et al. (2004) TCRP Report 102: Transit-Oriented Development in the United States: Experiences, Challenges, and Prospects, Transportation Research Board, National Research Council, Washington, D.C.

Corbalis, Jay. (2013). Development-oriented transit: How value-capture launched DC’s newest neighborhood. Smart Growth America. Retrieved from: http://www.smartgrowthamerica.org/2013/06/04/development-oriented-transit-how-value-capture-launched-dcs-newest-neighborhood/

MacCleery, Rachel and Tarr, Jonathan. (February 29, 2012) NoMa: The Neighborhood That Transit Built. UrbanLand. Retrieved from: http://urbanland.uli.org/development-business/noma-the-neighborhood-that-transit-built/

Mathur, Shishir and Smith, Adam. (May 2012). A Decision-support Framework for Using Value Capture to Fund Public Transit: Lessons From Project-Specific Analyses. Mineta Transportation Institute. Retrieved from: http://transweb.sjsu.edu/PDFs/research/1004-decision-support-framework-value-capture-public-transit-funding.pdf

Schrag, Zachary. (2001). Mapping Metro, 1955-1968: Urban, Suburban, and Metropolitan Alternatives. Washington History, Vol. 13, No. 1 (Spring/Summer, 2001), pp. 4-23. Retrieved from: http://www.jstor.org/stable/40073484?&seq=1#page\_scan\_tab\_contents

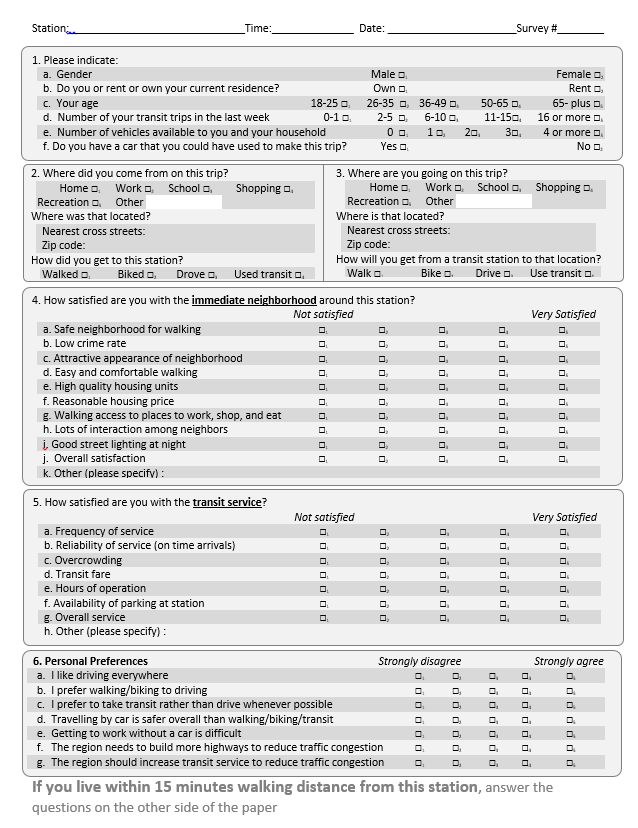
Transit-Oriented Development in the United States: Experiences, Challenges and Prospects. (2004). Volume 102 of Report (Transit Cooperative Research Program), Transporation Research Board. Retrieved from: https://books.google.com/books?id=a6\_\_pNpM44MC&pg=PA26&lpg=PA26&dq=bethesda+station+joint+development&source=bl&ots=8TJ4oiG3on&sig=IC6MPxAAh0OR1YZHaiWOqPpFs7g&hl=en&sa=X&ei=DbMRVYj8PNL3yQTHz4DQCA&ved=0CD0Q6AEwBQ#v=onepage&q=bethesda%20station%20joint%20development&f=false

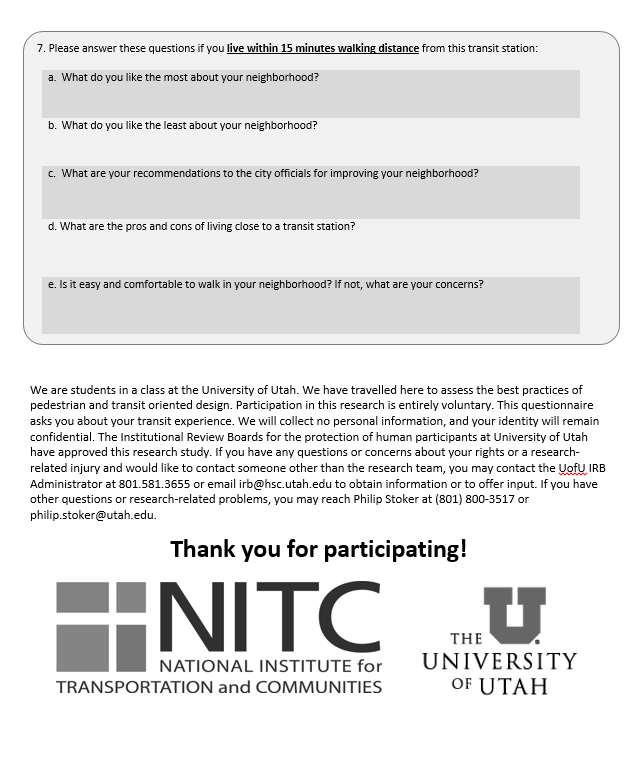
Rosslyn-Ballson Corridor. (n.d.) Retrieved from: http://projects.arlingtonva.us/planning/smart-growth/rosslyn-ballston-corridor/

Wogan, J.B. (February 2015). “Why D.C.’s Affordable Housing Protections Are Losing a War with Economics”, Governing Magazine, Retrieved from: http://www.governing.com/topics/urban/gov-washington-affordable-housing-protections-gentrification-series.html

National Low Income Housing Coalition. (May 16, 2014.) 40 Years Ago: Montgomery County, Maryland Pioneers Inclusionary Zoning. Retrieved from: http://nlihc.org/article/40-years-ago-montgomery-county-maryland-pioneers-inclusionary-zoning

# Appendix A: Questionnaire and Urban Design Audit





**Urban Design Audit instrument:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **measuring urban design qualities scoring sheet** | | | | auditor |  |  |
| **street segment:** | |  |  | date & time | |  |
| **side of street:** | |  |  | **recorded** |  | **(multiplier) x** |
| **step** |  |  |  | **value** | **multiplier** | **(recorded value)** |
| **imageability** | |  |  |  |  |  |
| 1. number of courtyards, plazas, and parks (both sides, within study area) | | | |  | 0.41 | 0.00 |
| 2. number of major landscape features (both sides, beyond study area) | | | |  | 0.72 | 0.00 |
| 3. proportion historic building frontage (both sides, within study area) | | | |  | 0.97 | 0.00 |
| 4. number of buildings with identifiers (both sides, within study area) | | | |  | 0.11 | 0.00 |
| 5. number of buildings with non-rectangular shapes (both sides, within study area) | | | |  | 0.08 | 0.00 |
| 6. presence of outdoor dining (your side, within study area) | | | |  | 0.64 | 0.00 |
| 7. number of people (your side, within study area) | | | |  | 0.02 | 0.00 |
| 8. noise level (both sides, within study area) | | |  |  | -0.18 | 0.00 |
|  |  |  |  |  | add constant | +2.44 |
|  |  |  |  |  | **imageablity score** | 2.44 |
| **enclosure** |  |  |  |  |  |  |
| 1. number of long sight lines (both sides, beyond study area) | | | |  | -0.31 | 0.00 |
| 2a. proportion street wall (your side, beyond study area) | | | |  | 0.72 | 0.00 |
| 2b. proportion street wall (opposite side, beyond study area) | | | |  | 0.94 | 0.00 |
| 3a. proportion sky (ahead, beyond study area) | | | |  | -1.42 | 0.00 |
| 3b. proportion sky (across, beyond study area) | | | |  | -2.19 | 0.00 |
|  |  |  |  |  | add constant | +2.57 |
|  |  |  |  |  | **enlosure score** | 2.57 |
| **human scale** | |  |  |  |  |  |
| 1. number of long sight lines (both sides, beyond study area) | | | |  | -0.74 | 0.00 |
| 2. proportion windows at street level (your side, within study area) | | | |  | 1.10 | 0.00 |
| 3. average building heights (your side, within study area) | | | |  | -0.003 | 0.00 |
| 4. number of small planters (your side, within study area) | | | |  | 0.05 | 0.00 |
| 5. number of pieces of street furniture and other street items (your side, within study area) | | | |  | 0.04 | 0.00 |
|  |  |  |  |  | add constant | +2.61 |
|  |  |  |  |  | **human scale score** | 2.61 |
| **transparency** | |  |  |  |  |  |
| 1. proportion windows at street level (your side, within study area) | | | |  | 1.22 | 0.00 |
| 2. proportion street wall (your side, beyond study area) | | | |  | 0.67 | 0.00 |
| 3. proportion active uses (your side, within study area) | | | |  | 0.53 | 0.00 |
|  |  |  |  |  | add constant | +1.71 |
|  |  |  |  |  | **transparency score** | 1.71 |
| **complexity** |  |  |  |  |  |  |
| 1. number of buildings (both sides, beyond study area) | | | |  | 0.05 | 0.00 |
| 2a. number of basic building colors (both sides, beyond study area) | | | |  | 0.23 | 0.00 |
| 2b. number of accent colors (both sides, beyond study area) | | | |  | 0.12 | 0.00 |
| 3. presence of outdoor dining (your side, within study area) | | | |  | 0.42 | 0.00 |
| 4. number of pieces of public art (both sdies, within study area) | | | |  | 0.29 | 0.00 |
| 5. number of people (your side, within study area) | | | |  | 0.03 | 0.00 |
|  |  |  |  |  | add constant | +2.61 |
|  |  |  |  |  | **complexity score** | 2.61 |
|  |  |  |  |  |  |  |