SPARKING OFF WALKABILITY

A Computational Approach of Urban Network Analysis on Walkability in TOD Neighborhoods

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GREAT STREETS

WALKABILITY

WALKABILITY PARAMETERS

For the New Urbanists, the solution to today’s issues is not the American suburban model but rather the traditional walkable neighborhood of the past that is compact, walkable, and at human scale (a model that is more common in Europe), as stipulated in Principles 11 and 12 of their charter: “Neighborhoods should be compact, pedestrian-friendly, and mixed-use,” and “many activities of daily living should be within walking distance” (“The Chapter of The New Urbanism”).

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WALKABILITY

Specks claims that four conditions must be simultaneously fulfilled to get people to walk rather than drive:

4 CONDITIONS:

A PROPER REASON TO WALK (BALANCE OF USES)

A SAFE WALK (REALITY & PERCEPTION)

A COMFORTABLE (SPACE & ORIENTATION)

AN INTERESTING WALK (SIGN OF HUMANITY)

Jane Jacobs claims, streets are an important part of the built form. She notes, “Streets and their sidewalks, the main public spaces of a city are its most vital organs(...). If a city’s streets look interesting, the city looks interesting; if they look dull, the city looks dull” (1961, 30). She argues that what makes a city vibrant is busy street life, or what she calls the “The ballet of the good city sidewalk” (1961, 50). There are also valuable things they “serve as locations of public expression” (Jacobs, Allan 1993). From his survey of more than 40 cities around the world, Allan Jacobs was able to sum up the most distinguishable qualities of good streets to consider when planning walkable environment and designing street network:

QUALITIES OF GOOD STREETS:

■ NARROW LANES ■ ATTRAACTIVE DESTINATIONS

■ SMALL BLOCKS ■ GOOD TRANSPORTATION SYSTEMS

■ INTERESTING ARCHITECTURE ■ LIVELY STREETS

Americans don’t walk a lot: only 9% of their trips are made by foot whereas it represents 36% in Sweden, for example (Pucher 2003).

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WALKABILITY

The five-minute walk or the quarter-mile pedestrian shed is commonly accepted as being the comfortable walking distance someone is willing to walk. In fact, the concept is not an idea of the New Urbanism movement since Clarence Perry used the notion when conceptualizing “The Neighborhood Unit” (in 1929) with a church, school, and shops, and bounded by major streets (Lerman 2015). His diagram shows a mix of uses, narrow streets, and short walking distances.

The conventional suburban model of development provides very little connectivity from the residences to the places of business making it very auto-dependent.

The traditional neighborhood includes a high level of connectivity allowing actual walk distances to nearly meet the ¼ mile radius.

The problem with the ¼ mile radius circle is that the distances between two points on a plane are given as a straight-line distance (also called Euclidean or “as the crow flies” distance), which means that it does not take into account safety rules and obstacles:
- Properly connected
- Without barriers
- Without gaps
- Ample width
- Landscape
- Lighting
- Signage
- Paved
It is quite challenging to provide a coherent review of configurational studies of the built environment since the material leaps over the multiple disciplines in several fields.

ARCHITECTURE
ENVIRONMENTAL COGNITION
TRANSPORTATION RESEARCH
PLANNING
URBAN GEOGRAPHY

*Even the most outstanding individual buildings or public spaces can fail to be appropriate for their users if the spatial configuration around the projects disincentivizes their workings* (Jan Gehl 2010).
The biggest advantage of Graph theory is that it can be applied by the use of very little data and easily improved from previous results. Hence it is very easy to apply Graph theory to select which spaces to develop.

* Beta $\beta$ values that are higher (closer to 1) indicate stronger aversion towards walking distance.
ANALYSIS PROCESS FRAMEWORK

QGIS & EXCEL

QGIS & EXCEL

RHINOCEROS 3D & EXCEL

EXCEL & DATABASE

TYPE
DATA

TYPE
STRUCTURE THE DATA

TYPE
LINK DATA & GEOMETRY

TYPE
KNOWLEDGE

FORM
VISUALIZATION

FORM
DATA BASE TABLE

FORM
2D GEOMETRIES

FORM
QUANTITATIVE RESULTS

PROCESS MINE / GATHER

PROCESS CLASSIFY / FILTER

PROCESS CONNECT / SEQUENCE

PROCESS EVALUATE / UNDERSTAND

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WAIPAHU - TOD 1/4 MILE

WESTLOCH STATION

TRANSIT CENTER STATION

EXISTING CONDITIONS

- COMMERCIAL ZONING
- INDUSTRIAL ZONING
- OTHER ZONING TYPE
- RESIDENTIAL ZONING

EXISTING CONDITIONS

- COMMERCIAL ZONING
- INDUSTRIAL ZONING
- OTHER ZONING TYPE
- RESIDENTIAL ZONING

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## Data Organization

### Buildings

<table>
<thead>
<tr>
<th>Name</th>
<th>Coordinate</th>
<th>Category:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>ASSISTED LIVING/FOOD RETAIL/RELIGIOUS/BUSINESS HEALTH/RESIDENTIAL/INDUSTRIAL GOVERNMENT/GAS STATION COMMUNITY/PARKS Entertainment/MUSEUM/BRIDGES LIBRARY DAYCARE/PUBLIC HOUSING</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lot size</th>
<th>Building size</th>
<th>Building Height</th>
<th>FAR</th>
<th>Year Built</th>
<th>Property Value</th>
<th># Bedroom</th>
<th># People</th>
</tr>
</thead>
</table>

### Rail

<table>
<thead>
<tr>
<th>name</th>
<th>x</th>
<th>y</th>
<th>z</th>
<th>Ra#</th>
</tr>
</thead>
</table>

### Bus

<table>
<thead>
<tr>
<th>Stop#</th>
<th>x</th>
<th>y</th>
<th>z</th>
<th>Bus#</th>
<th>BusRoute</th>
</tr>
</thead>
</table>

### Bike Racks

<table>
<thead>
<tr>
<th>Rack#</th>
<th>x</th>
<th>y</th>
<th>z</th>
<th># of Racks</th>
</tr>
</thead>
</table>

### Intersections

<table>
<thead>
<tr>
<th>Name</th>
<th>x</th>
<th>y</th>
<th>z</th>
</tr>
</thead>
</table>

### Parking

<table>
<thead>
<tr>
<th>Name or Type</th>
<th>x</th>
<th>y</th>
<th>z</th>
<th>Public or Private</th>
<th>Count of Stall #</th>
</tr>
</thead>
</table>

### Tax Parcels

<table>
<thead>
<tr>
<th>TMK</th>
<th>x</th>
<th>y</th>
<th>z</th>
<th>Size</th>
<th>Zoning</th>
<th>Max Height</th>
<th>FAR</th>
<th>owner</th>
</tr>
</thead>
</table>

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PROVIDING QUANTITATIVE MATERIALS ON WAIPAHU THROUGH A COMPUTATIONAL MODEL ANALYSIS.

BY DOING THIS ANALYSIS WE EXPECT TO SHOW THE USAGE AND VALIDITY OF OUR COMPUTATIONAL MODEL IN THIS TYPE OF URBAN DESIGN STUDIES.
RESIDENTIAL TO MULTIMODAL TRANSPORTATION

WALKABILITY.

“Fostering more options to compete with driving as the preferred means of getting around is a primary purpose of TOD”

RESIDENTIAL

TOD

BUS

PARKING
This analysis shows that 77% of the residential houses have at least 1 bus stop and at most 16 within a 1/4 mile walking distance. It means that 23% of the other residential house are out of the 1/4 mile walking distance range of any bus stops.

This analysis shows that the state residential house have at most 12 bus stops within a 1/4 mile walking distance.

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BUS STOPS ARE REACHED BY 77% OF TOTAL RESIDENTIAL HOUSES

23% ARE NOT WITHIN REACH OF 1 BUS STOPS WITHIN 1/4 MILE
This analysis shows that a residential house has at least 1 Parking stall and at most 633 within a 1/4 mile walking distance. In average each residential house has 240 stalls out of 7918 total in the Waipahu area.

This analysis shows that a state residential house has at most 287 Parking stalls within a 1/4 mile walking distance.

This analysis shows that a state residential house has at most 287 Parking stalls within a 1/4 mile walking distance.
This analysis shows the density of business and POI in the Waipahu area.
This analysis shows the residential house with at least 1 Business and at most 40 within a 1/4 mile walking distance in the Waipahu area.

This analysis shows the state residential house with at most 40 Business within a 1/4 mile walking distance in the Waipahu area.

This analysis shows the state residential house with at most 40 Business within a 1/4 mile walking distance in the Waipahu area.
This analysis shows the residential house with at least 1 Place of Interest and at most 72 within a 1/4 mile walking distance.

This analysis shows the state residential house with at most 73 Place of Interest within a 1/4 mile walking distance.

This analysis shows the state residential house with at most 73 Place of Interest within a 1/4 mile walking distance.
1/4 Mile - OVERALL RESIDENTIAL TO ENTERTAINMENT RELATIONSHIPS

This analysis shows the residential house with at least 1 entertainment establishment and at most 3 other within a 1/4 mile walking distance.

LEGEND

1/4 Mile - STATE RESIDENTIAL TO ENTERTAINMENT RELATIONSHIPS

This analysis shows the state residential house with at most 2 entertainment establishment within a 1/4 mile walking distance.

LEGEND

1/4 Mile - 3D VIEW STATE RESIDENTIAL TO ENTERTAINMENT RELATIONSHIPS

This analysis shows the state residential house with at most 2 entertainment establishment within a 1/4 mile walking distance.

LEGEND

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This analysis shows the residential house with at least 1 Food establishment and at most 23 within a 1/4 mile walking distance in the Waipahu area.

This analysis shows the state residential house with at most 23 Food establishment within a 1/4 mile walking distance in the Waipahu area.

This analysis shows the state residential house with at most 23 Food establishment within a 1/4 mile walking distance in the Waipahu area.
This analysis shows 993 residential houses with at least 1 Park within a 1/4 mile walking distance.

This analysis shows state residential houses with at least 1 Park within a 1/4 mile walking distance.

This analysis shows state residential houses with at least 1 Park within a 1/4 mile walking distance.
1/4 Mile - OVERALL RESIDENTIAL TO TOD RELATIONSHIPS

This analysis shows 5 Residential buildings within 1/4 mile of the WestLoch Station and 77 Residential buildings within 1/4 mile of the Transit Center Station.

1/4 Mile - STATE RESIDENTIAL TO TOD RELATIONSHIPS

This analysis shows 0 Residential buildings within 1/4 mile of the WestLoch Station and 9 Residential buildings within 1/4 mile of the Transit Center Station.

1/4 Mile - 3D VIEW STATE RESIDENTIAL TO TOD RELATIONSHIPS

This analysis shows 0 Residential buildings within 1/4 mile of the WestLoch Station and 9 Residential buildings within 1/4 mile of the Transit Center Station.
## General Theory for Walkability

<table>
<thead>
<tr>
<th>Useful</th>
<th>Safe</th>
<th>Comfortable</th>
<th>Interesting</th>
</tr>
</thead>
</table>

**Skinny Streets**
Narrow streets that reduce speeding, vehicle crashes, street construction cost, pedestrian crossing distances.

**Shared Streets**
Widened streets for a single plane with reduced speed limits that allows pedestrians to move freely.

Prioritizes pedestrian and bike networks . . . not cars.
WAIPAHU STREETS ONLY
TOTAL STREETS LENGTH: 282,614.51 FT OR 53 MILES

1/4 Mile - INTERSECTIONS TO POI RELATIONSHIPS
LEGEND

This analysis shows the intersections with the most POI within a 1/4 mile walking distance.
This analysis shows the streets with the most potential passing-by between Intersections and POI within a 1/4 mile walking distance.

This analysis shows the intersections with the most potential passing-by of people going from a bus stop to a POI within a 1/4 mile walking distance of each bus stop.
PUBLIC HOUSING

The existing Hoolulu and Kamalu public housing in the Pouhala TOD should be renovated through Rental Assistance Demonstration (RAD) rather than demolishing and recon- structing the buildings.

The State TOD Strategic Plan describes plans to demolish Hawai‘i Public Housing Authority (HPHA) elderly housing projects Hoolulu and Kamalu in Waipahu.
This analysis shows that a single POI has at most 5 public housing within a 1/4 mile walking distance.

This analysis shows that a STATE PARCEL has at most 73 POI within a 1/4 mile walking distance.

This analysis shows that a STATE PARCEL has at most 73 POI within a 1/4 mile walking distance.
1/4 Mile - OVERALL PUBLIC HOUSING TO INTERSECTIONS RELATIONSHIPS

This analysis shows the State Public housing with the most intersections within a 1/4 mile walking distance which can indicate the potential for street interactions.

1/4 Mile - STATE PUBLIC HOUSING TO INTERSECTIONS RELATIONSHIPS

This analysis shows the state public housing with the most intersections within a 1/4 mile walking distance which can indicate the potential for street interactions.

1/4 Mile - 3D VIEW STATE PUBLIC HOUSING TO INTERSECTION RELATIONSHIPS

This analysis shows the state public housing with the most intersections within a 1/4 mile walking distance which can indicate the potential for street interactions.
This analysis shows that a single Parking stall has at most 5 public housing within a 1/4 mile walking distance.

This analysis shows that a state public housing has at most 287 Parking stalls within a 1/4 mile walking distance.

This analysis shows that a state public housing has at most 287 Parking stalls within a 1/4 mile walking distance.
This analysis shows that a State Public Housing has at least 2 Bus stop and at most 12 within a 1/4 mile walking distance.
DISCUSSION:
FOCUS OF THIS ANALYSIS

PUBLIC TRANSPORTATION

STREET INTERSECTIONS

RESIDENTIAL BUILDINGS

COMMERCIAL BUILDINGS

PUBLIC FACILITIES

PLACES OF INTEREST

FIVE METRICS:

- REACH
- CLOSENESS
- GRAVITY
- STRAIGHTNESS
- BETWEENNESS

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DISCUSSION:
ADDITIONAL DATA NEEDED TO ENRICH THE ANALYSIS:

- Population by Buildings
- Business Annual Revenue
- Building Age - End of Construction
- Streetscape Survey

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THANK YOU

This computational analysis on walkability in Waipahu Transit Oriented Development (TOD) neighborhoods is supported by State of Hawaii Office of Planning and developed in collaboration with University of Hawaii Community Design Center (UHCDC).