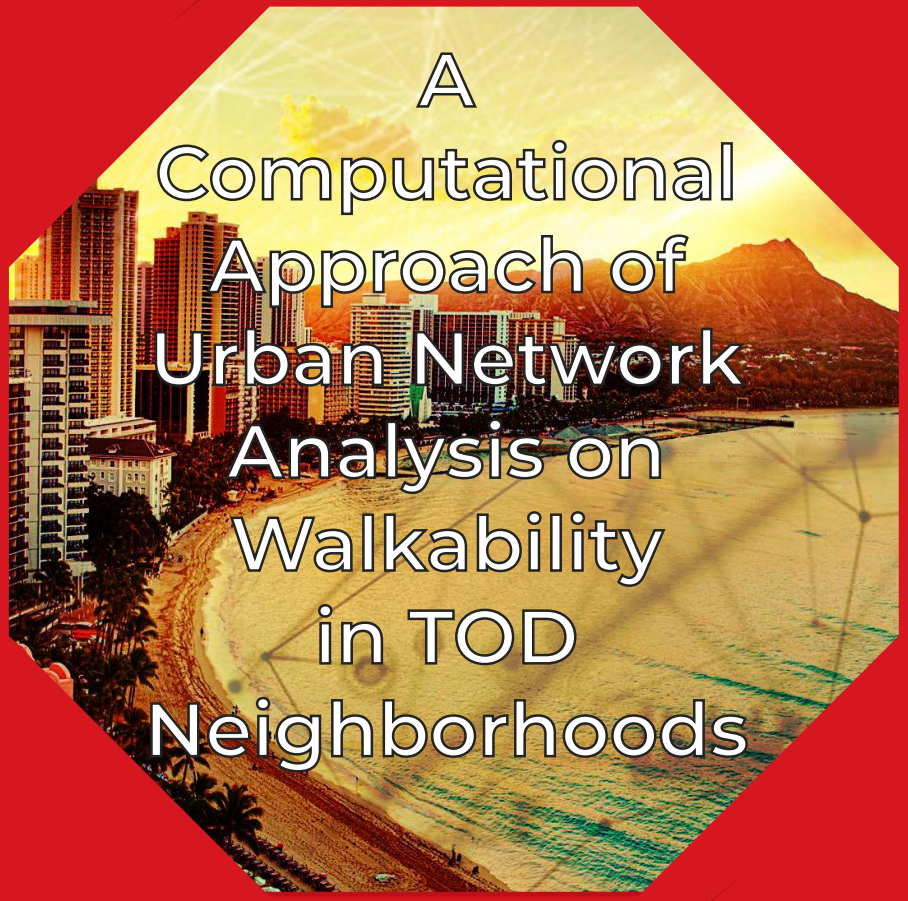
SPARKING OFF WALKABILITY



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

KALANI MOLINA and HYOUNG-JUNE PARK
School of Architecture, University of Hawaii at Manoa

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").

KALANI MOLINA and HYOUNG-JUNE PARK - School of Architecture, University of Hawaii at Manoa

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
- ATTRACTIVE 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).

KALANI MOLINA and HYOUNG-JUNE PARK - School of Architecture, University of Hawaii at Manoa

WALKABILITY

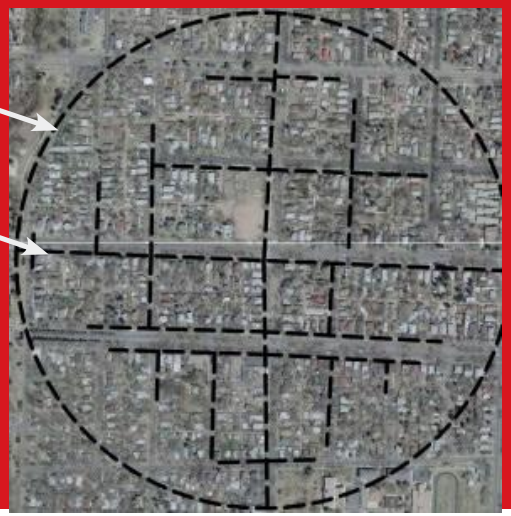
The five-minute walk or the quarter-mile pedestrian shed is commonly accepted as being the comfortable walking distance someone is willing to walk. In fact, the concept is not an idea of the New Urbanism movement since Clarence Perry used the notion when conceptualizing "The Neighborhood Unit" (in 1929) 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.

DROPPED CIRCLE: 1/4 MILE RADIUS

ACTUAL 1/4 MILE TRAVELED DISTANCES

The traditional neighborhood includes a high level of connectivity allowing actual walk distances to nearly meet the 1/4 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:

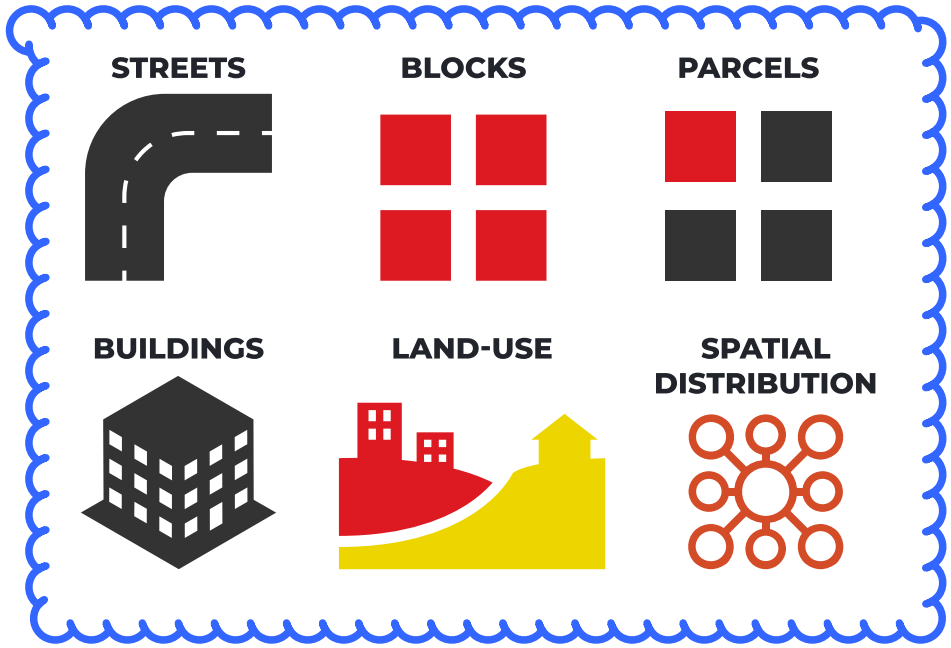
- Properly connected
- Without barriers
- Without gaps
- Ample width
- Landscape
- Lighting
- Signage
- Paved

COMPUTATIONAL APPLICATION

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

LIMITATIONS OF THIS STUDY

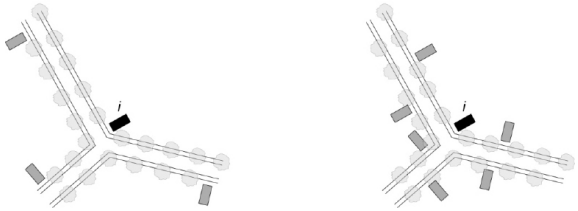


"Even the most outstanding individual buildings or public spaces can fail to be appropriate for their users if the spatial configuration around the projects disincentivizes their workings" (Jan Gehl 2010).

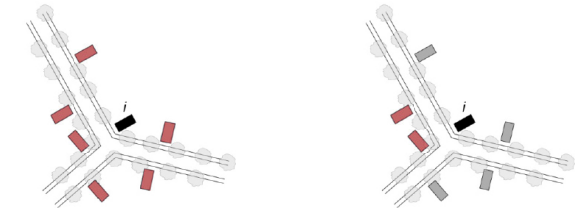
UNA - METHODS - *INDEX*

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.

- REACH +

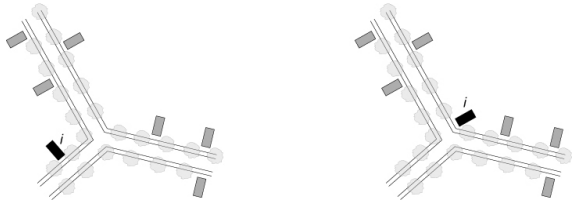


- GRAVITY* +

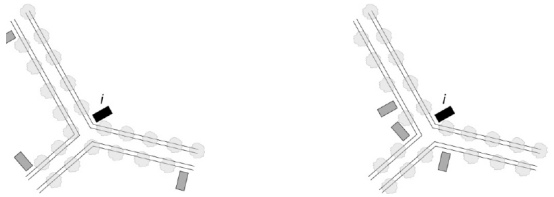


β CLOSER TO "0" β CLOSER TO "1"

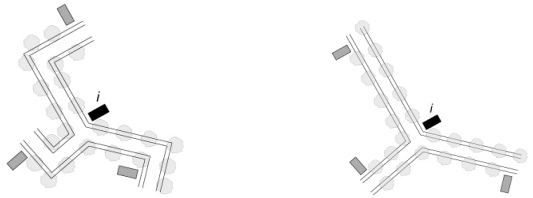
- BETWEENNESS +



- CLOSENESS +



- STRAIGHTNESS +



** Beta **β** values that are higher (closer to 1) indicate stronger aversion towards walking distance.*

QUANTITATIVE

QUALITATIVE

ANALYSIS PROCESS FRAMEWORK

QGIS

&

EXCEL

TYPE DATA

FORM VISUALIZATION

PROCESS MINE / GATHER

QGIS

&

EXCEL

TYPE STRUCTURE THE DATA

FORM DATA BASE TABLE

PROCESS CLASSIFY / FILTER

RHINOCEROS 3D

&

UNA PLUG-IN

TYPE LINK DATA & GEOMETRY

FORM 2D GEOMETRIES

PROCESS CONNECT/ SEQUENCE

EXCEL

&

DATABASE

TYPE KNOWLEDGE

FORM QUANTITATIVE RESULTS

PROCESS EVALUATE / UNDERSTAND

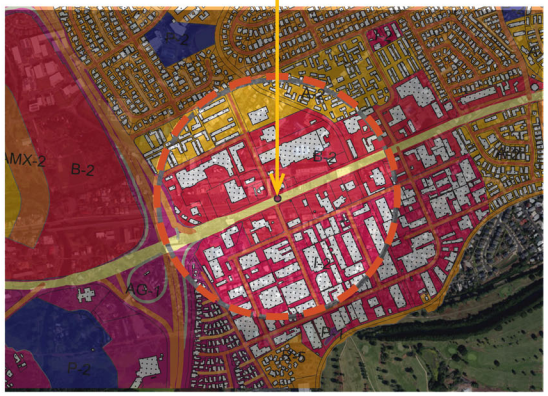
KALANI MOLINA and HYOUNG-JUNE PARK - School of Architecture, University of Hawaii at Manoa

WAIPAHU

CASE STUDY

WAIPAHU - TOD 1/4 MILE

WESTLOCH STATION



EXISTING CONDITIONS

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

TRANSIT CENTER STATION

EXISTING CONDITIONS

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

DATA ORGANIZATION

BUILDINGS

Name	Coordinate			Category:	Lot size	Building size	Building Height	Building Zoning	FAR	Year Built	Property Value	# Bedroom	# People
	X	Y	Z	ASSISTED LIVING, FOOD, RETAIL, RELIGIOUS, BUSINESS, HEALTH, RESIDENTIAL, BEAUTY, GOVERNMENT, GAS STATION, COMMUNITY, PARKS, ENTERTAINMENT, BRIDGES, LIBRARY, DAYCARE, PUBLIC HOUSING.								

RAIL

name	x	y	z	Rail#

BUS

Stop#	x	y	z	Bus#	BusRoute

BIKE RACKS

Rack#	x	y	z	# of Racks

INTERSECTIONS

Name	x	y	z	

PARKING

Name or Type	x	y	z	Public or Private	Count of Stall #
Street Structure Parking lot Residential					

TAX PARCELS

TMK	x	y	z	Size	Zoning	Max Height	FAR	owner

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

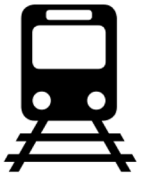
KALANI MOLINA and HYOUNG-JUNE PARK - School of Architecture, University of Hawaii at Manoa

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"

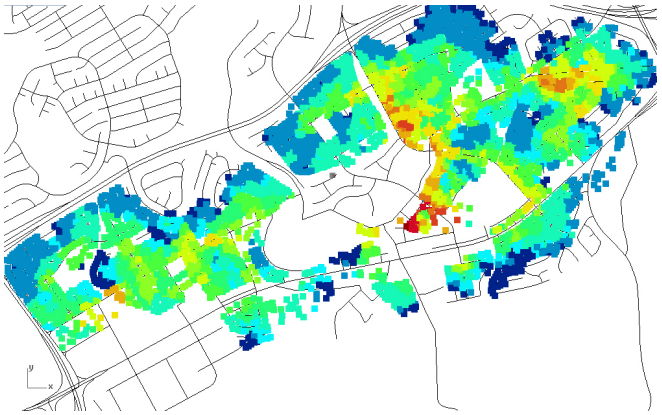
RESIDENTIAL



TOD

BUS

PARKING



1/4 Mile - OVERALL RESIDENTIAL TO BUS STOPS RELATIONSHIPS

LEGEND

16

1

This analysis shows that 77% of the residential houses have at least 1 bus stops 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.

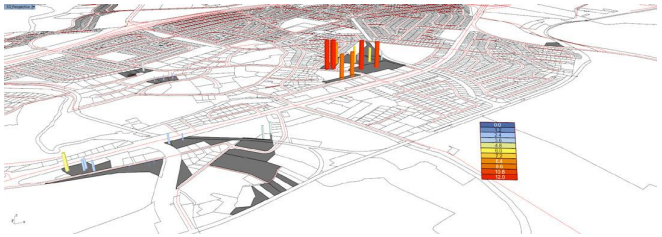
1/4 Mile - STATE RESIDENTIAL TO BUS STOPS RELATIONSHIPS

LEGEND

12

0

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



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

LEGEND

12

6

0

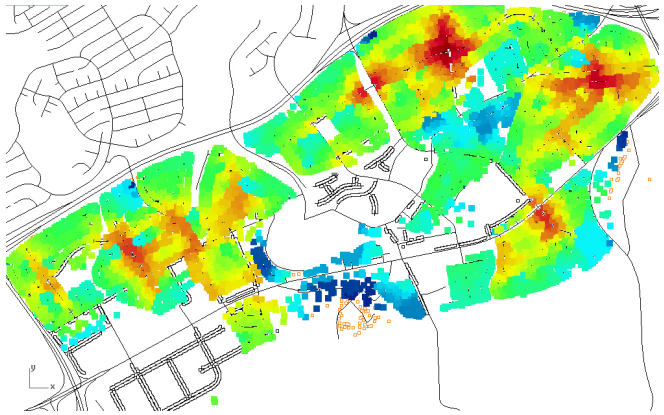
This analysis shows that the state residential houses have at most 12 bus stops within a 1/4 mile walking distance.

WAIPAHU BUS ROUTES

TOTAL BUS ROUTE LENGTH: 1603938.97 FT OR 303 MILES

BUS STOPS ARE REACHED BY 77% OF TOTAL RESIDENTIAL HOUSES

23% ARE NOT WITHIN REACH OF 1 BUS STOPS WITHIN 1/4 MILE



1/4 Mile - OVERALL RESIDENTIAL TO PARKING RELATIONSHIPS

LEGEND

633

1

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.

RATIO STREET PARKING 202
PARKING LOTS 7716

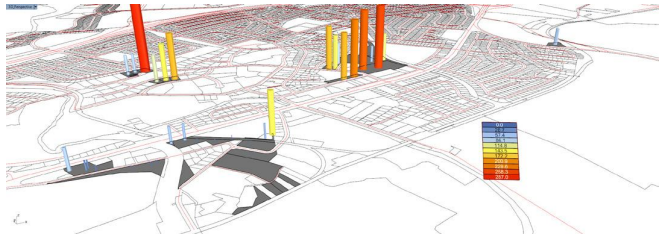
1/4 Mile - STATE RESIDENTIAL TO PARKING RELATIONSHIPS

LEGEND

287

0

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



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

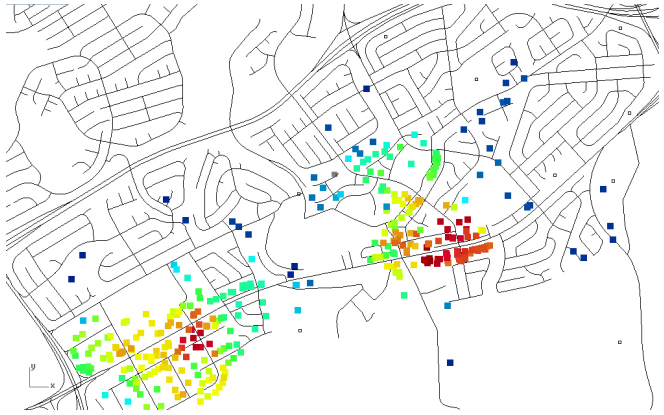
LEGEND

287

143.5

0

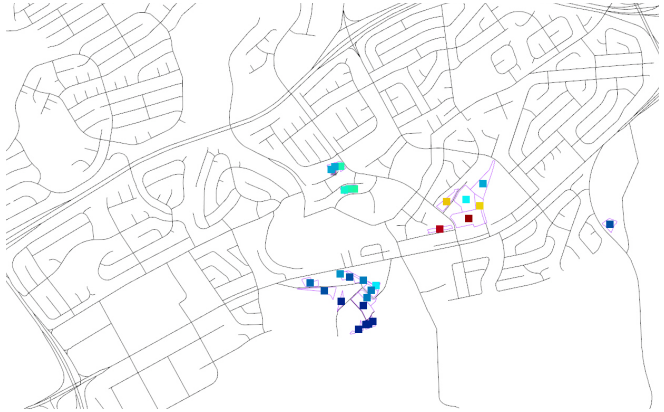
This analysis shows that a state residential house has at most 287 Parking stalls within a 1/4 mile walking distance.



1/4 Mile - OVERALL BUSINESS/POI TO BUSINESS/POI RELATIONSHIPS

LEGEND

This analysis shows the density of business and POI in the Waipahu area.



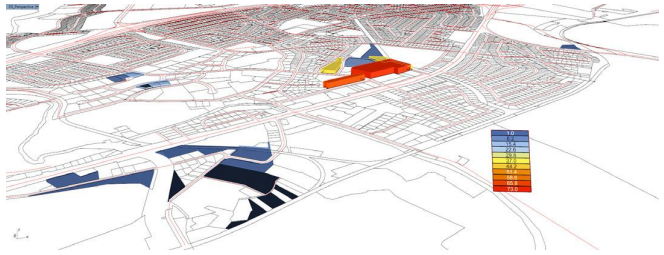
1/4 Mile - STATE BUSINESS/POI TO BUSINESS/POI RELATIONSHIPS

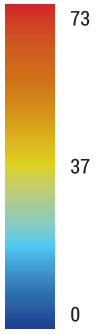
LEGEND

This analysis shows the density of state parcel's of business and POI in the Waipahu area.

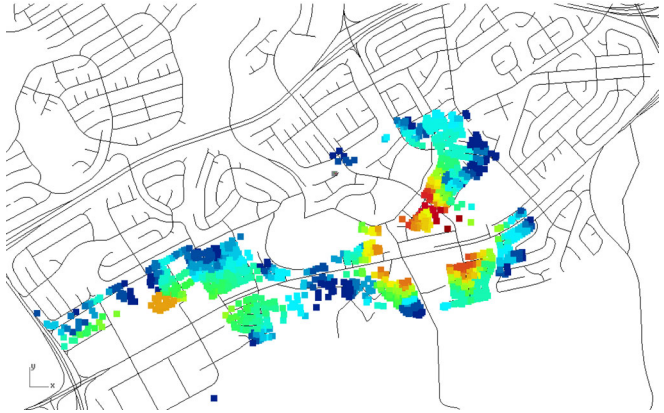
1/4 Mile - 3D VIEW STATE PARCELS TO BUSINESS/POI RELATIONSHIPS

LEGEND





This analysis shows the density of state parcel's of business and POI in the Waipahu area.



1/4 Mile - OVERALL RESIDENTIAL TO BUSINESS RELATIONSHIPS

LEGEND

40

1

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.

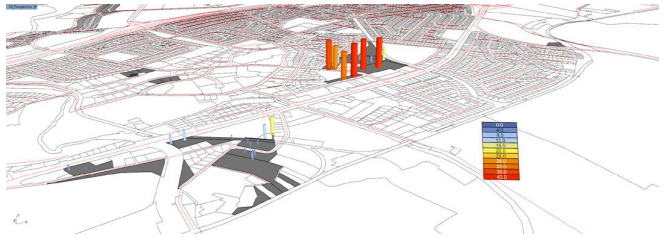
1/4 Mile - STATE RESIDENTIAL TO BUSINESS RELATIONSHIPS

LEGEND

40

0

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



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

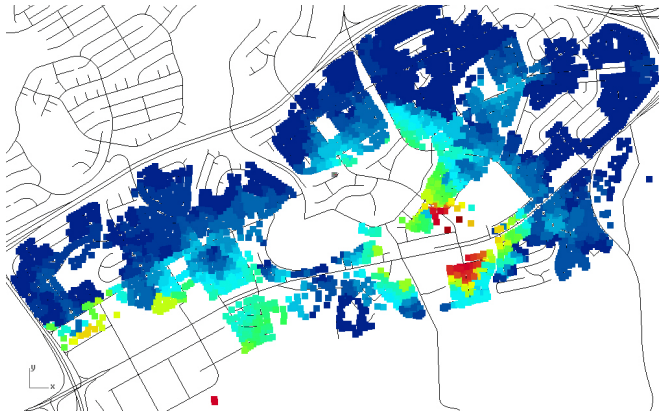
LEGEND

40

20

0

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



1/4 Mile - OVERALL RESIDENTIAL TO POI RELATIONSHIPS

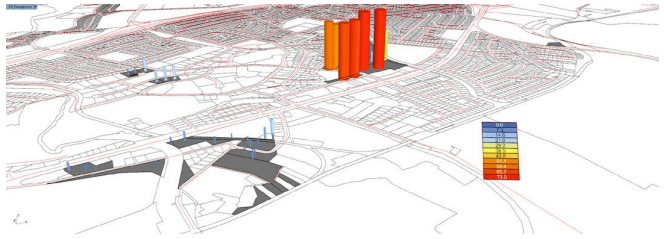
LEGEND

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

1/4 Mile - STATE RESIDENTIAL TO POI RELATIONSHIPS

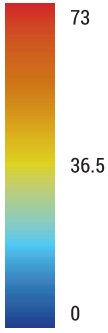
LEGEND

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



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

LEGEND



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

LEGEND

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

1/4 Mile - STATE RESIDENTIAL TO ENTERTAINMENT RELATIONSHIPS

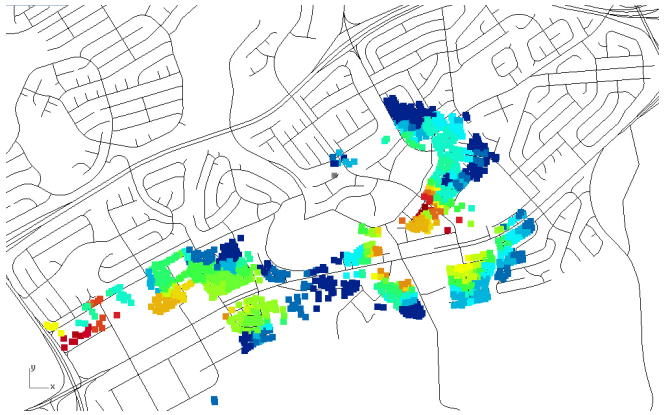
LEGEND

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

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

LEGEND

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



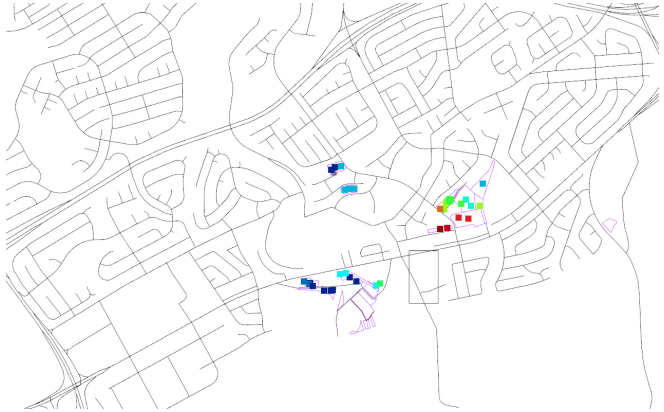
1/4 Mile - OVERALL RESIDENTIAL TO FOOD RELATIONSHIPS

LEGEND

23

1

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.



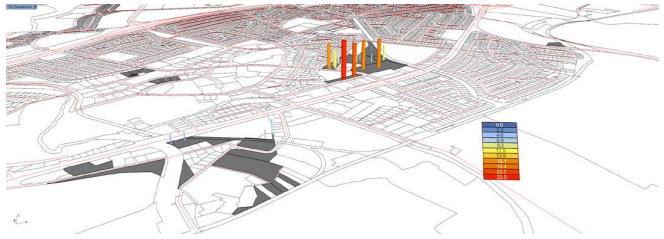
1/4 Mile - STATE RESIDENTIAL TO FOOD RELATIONSHIPS

LEGEND

23

0

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



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

LEGEND

23

11.5

0

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

1/4 Mile - RESIDENTIAL TO PARK RELATIONSHIPS

LEGEND

1

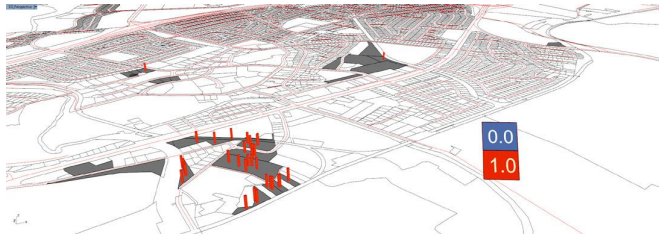
This analysis shows 993 residential houses with at least 1 Park within a 1/4 mile walking distance.

1/4 Mile - STATE RESIDENTIAL TO PARK RELATIONSHIPS

LEGEND

1

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

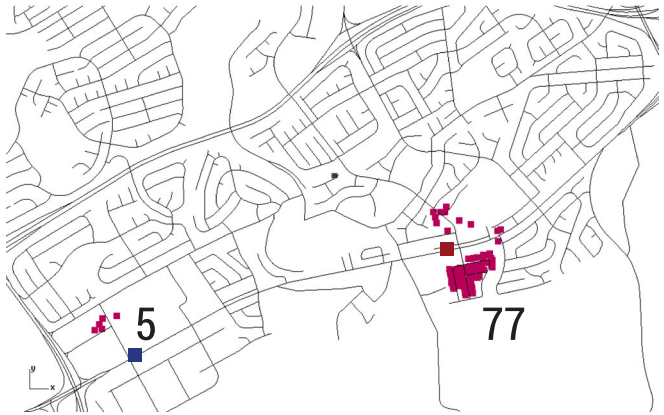


1/4 Mile - 3D VIEW STATE RESIDENTIAL TO PARK RELATIONSHIPS

LEGEND

1

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

LEGEND

77

5

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

LEGEND

9

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

LEGEND

9

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

Useful **Safe** **Comfortable** **Interesting**

Skinny Streets

Narrow streets that reduce speeding, vehicle crashes, street construction cost, pedestrian crossing distances

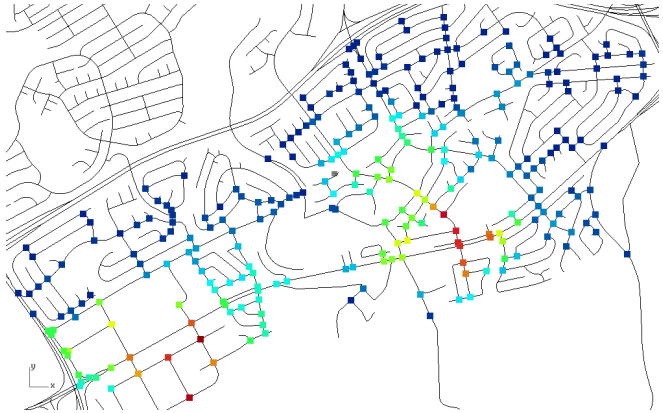
Shared Streets

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.

1/4 Mile - INTERSECTIONS TO POI BETWEENESS RELATIONSHIPS

LEGEND

191

1

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

1/4 Mile - BUS STOP TO POI TO INTERSECTIONS BETWEENESS RELATIONSHIPS

LEGEND

261

1

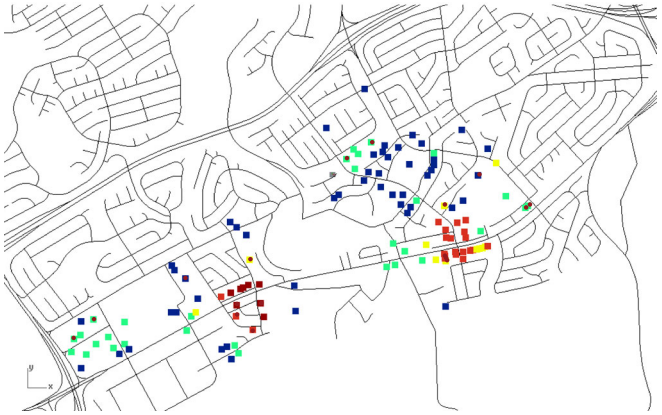
This analysis shows the intersections with the most potential passing-by of people going from a bus stop to a POI within a 1/4 mile walking distance of each bus stop.

PUBLIC HOUSING

https://www.apartments.com/kamalu-hoolulu-elderly-housing-waipahu-hi/b1f1bv9/

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

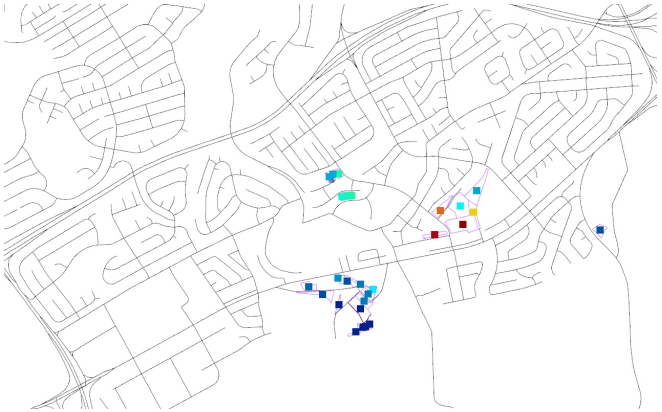
The State TOD Strategic Plan describes plans to demolish Hawai'i Public Housing Authority (HPHA) elderly housing projects Hoolulu and Kamalu in Waipahu.



1/4 Mile - OVERALL PUBLIC HOUSING TO POI RELATIONSHIPS

LEGEND

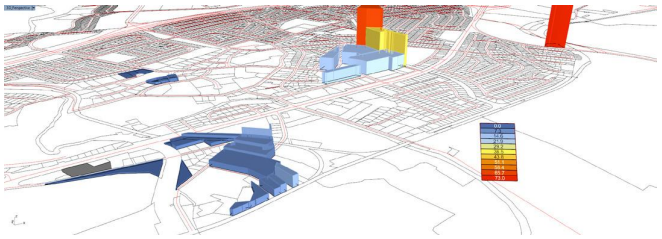
This analysis shows that a single POI has at most 5 public housing within a 1/4 mile walking distance.



1/4 Mile - STATE PARCEL TO POI RELATIONSHIPS

LEGEND

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



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

LEGEND

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

LEGEND

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

LEGEND

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

LEGEND

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.

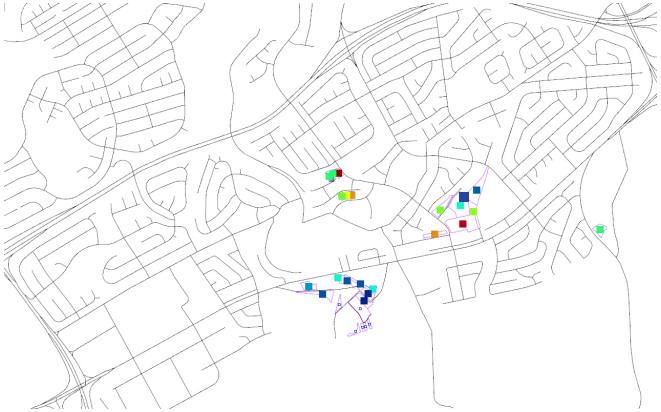
1/4 Mile - OVERALL PUBLIC HOUSING TO PARKING RELATIONSHIPS

LEGEND

5

1

This analysis shows that a single Parking stall has at most 5 public housing within a 1/4 mile walking distance.



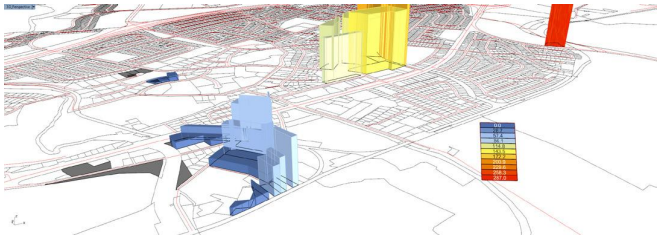
1/4 Mile - STATE PUBLIC HOUSING TO PARKING RELATIONSHIPS

LEGEND

287

3

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



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

LEGEND

287

143.5

0

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

1/4 Mile - OVERALL PUBLIC HOUSING TO BUS STOP RELATIONSHIPS

LEGEND

12

2

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.

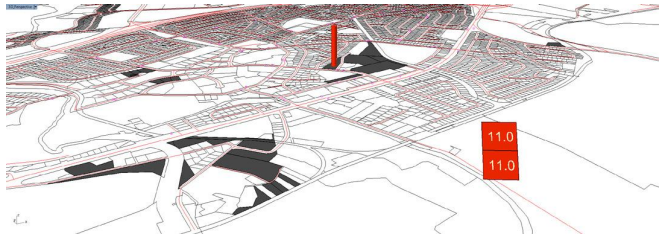
1/4 Mile - STATE PUBLIC HOUSING TO BUS STOP RELATIONSHIPS

LEGEND

11

0

This analysis shows that a State Public Housing has at most 11 Bus stop within a 1/4 mile walking distance.



1/4 Mile - STATE PUBLIC HOUSING TO BUS STOP RELATIONSHIPS

LEGEND

11

This analysis shows that a State Public Housing has at most 11 Bus stop within a 1/4 mile walking distance.

DISCUSSION:

FOCUS OF THIS ANALYSIS

PUBLIC TRANSPORTATION

STREET INTERSECTIONS

RESIDENTIAL BUILDINGS

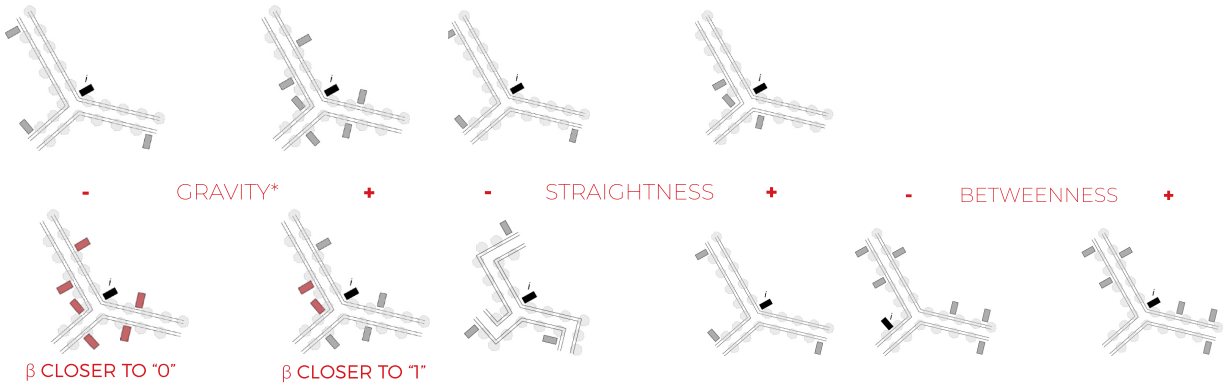
COMMERCIAL BUILDINGS

PUBLIC FACILITIES

PLACES OF INTEREST

FIVE METRICS:

- REACH +
- CLOSENESS +
- GRAVITY* +
- STRAIGHTNESS +
- BETWEENNESS +



β CLOSER TO "0"

β CLOSER TO "1"

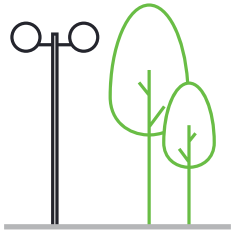
DISCUSSION:

ADDITIONAL DATA NEEDED TO ENRICH THE ANALYSIS:

POPULATION BY BUILDINGS

BUSINESS ANNUAL REVENUE

BUILDING AGE - END OF CONSTRUCTION



STREETSCAPE SURVEY

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).