An urban tissue analysis and conceptual toolbox.

MODALITY:

Mobility and form in Chicago's built environment

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CD 504 | Theories of Urban Design

What is modality?

There are many possible ways to move through a space. In a city, one can walk, run, bike, skateboard, scooter, drive, be a passenger, or take a train or bus. Depending on the design of that city, one may feel incentivized to take certain forms of transportation over others. Someone covering vast distances may want to drive or take a train, whereas someone going a short distance may walk or bike. Seasons and time of day influence these decisions as well; design that doesn't account for changes in weather or sunlight may shape people's transportation decisions, experiences, and perceptions.

Modality is thus an idea that represents the summation of people's lived experiences in relation to the built environment on a quotidian basis. How people perceive the world around them influences how they experience that world, and this is especially true for cities, which are dense environments manipulated by and for humans. The way we shape our cities influences the way we understand them, navigate through them, and recognize patterns within and among them.

This booklet will assess Chicago's built form by how it shapes modalities. Chicago's design presents and impacts at different scales, from large-scope, overarching frameworks of navigation to small-scale layouts of streetscapes. Putting these together, how does the design of Chicago's streets and buildings shape the way people move through, and experience, the city?

How does urban form shape modality?

Two contrasting perspectives offer insight as to how urban form can shape modality:

Top-down approach: Simple urban form (e.g. gridded streets, alignment to cardinal directions, straight lines, hierarchy of street types) makes navigation simple for directionally challenged people.

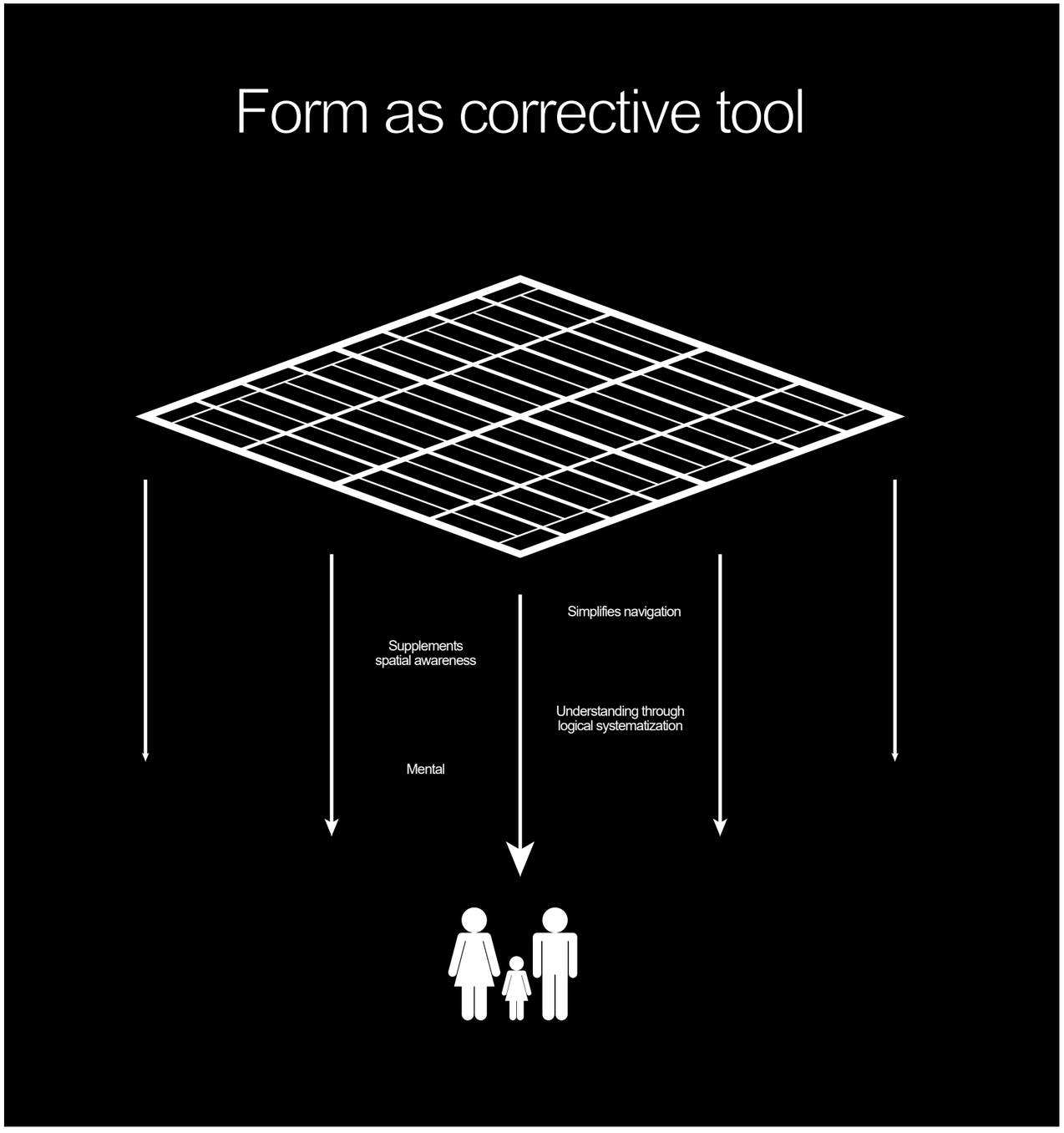
- Emphasizes: Legibility
- Omits: Accessibility

Under this approach, urban form is a "corrective tool" which people fall back on to assist them in navigating the vast urban environment. Top-down approaches don't necessarily emphasize accessibility in the sense that they don't consider "who" is navigating; the logic of urban form can be easily legible and mentally reproducible on a map, but not everyone may feel comfortable existing within that form on the ground.

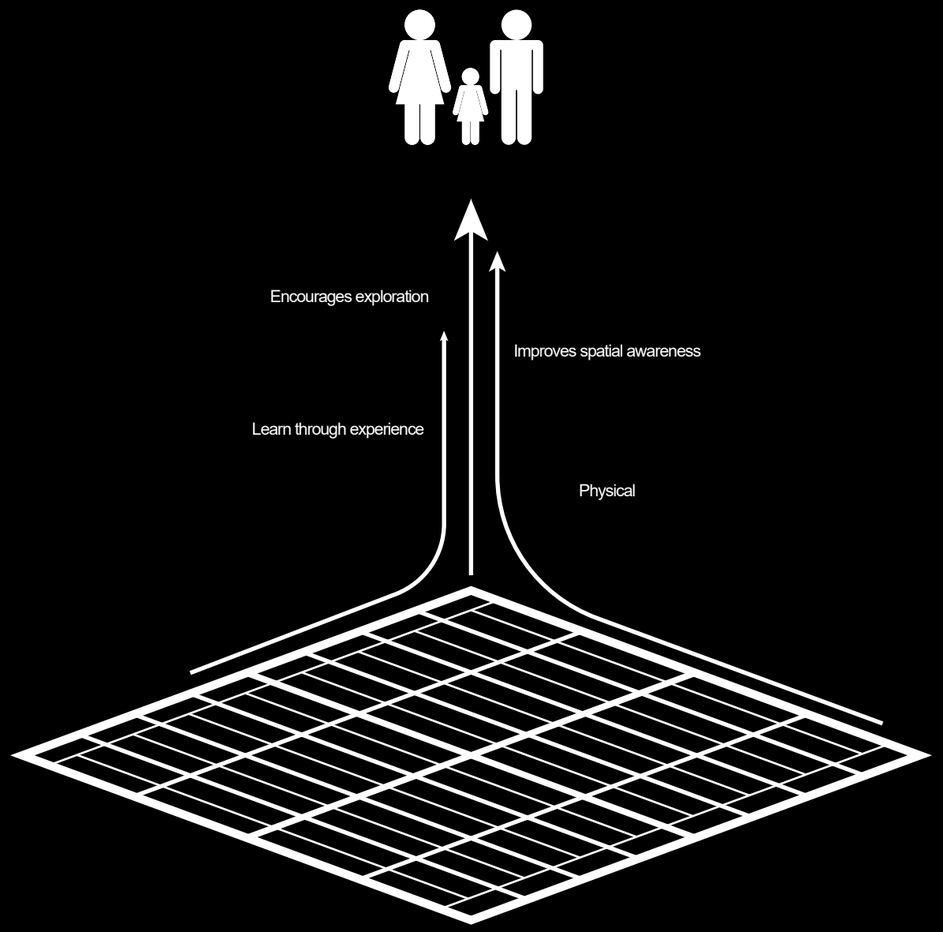
Bottom-up approach: Compact urban form (e.g. narrower, winding streets, mixed uses, higher building and intersection density, encouraging walking and biking) encourages exploration and improves people's navigation skills through experience.

- Emphasizes: Accessibility
- Omits: Legibility

Under this approach, urban form is a "nurturing instrument" which enables people to explore the world around them at a smaller scale and develop their own spatial awareness. In this framework, more of the built environment is accessible to people, but it may not have a logic to it, and may be much more difficult to reproduce mentally or give directions to somebody experiencing it for the first time.



Form as nurturing instrument



How does Chicago exemplify these approaches?

Somewhere in the middle, these two perspectives meet. A legible neighborhood that is also accessible is possible, just as a neighborhood that is neither legible nor accessible is also possible.

Chicago is a city that largely follows the top-down approach. Its streets are gridded and run north-south and east-west, very few streets change direction and its main streets are almost always entirely straight, and there is a simple hierarchy of street types that is reproduced throughout the city. However, at a smaller scale, Chicago neighborhoods can be fairly accessible, with high building and intersection densities, mixed uses, and narrow streets that are safe for people to use whether they are walking, biking, or behind the wheel.

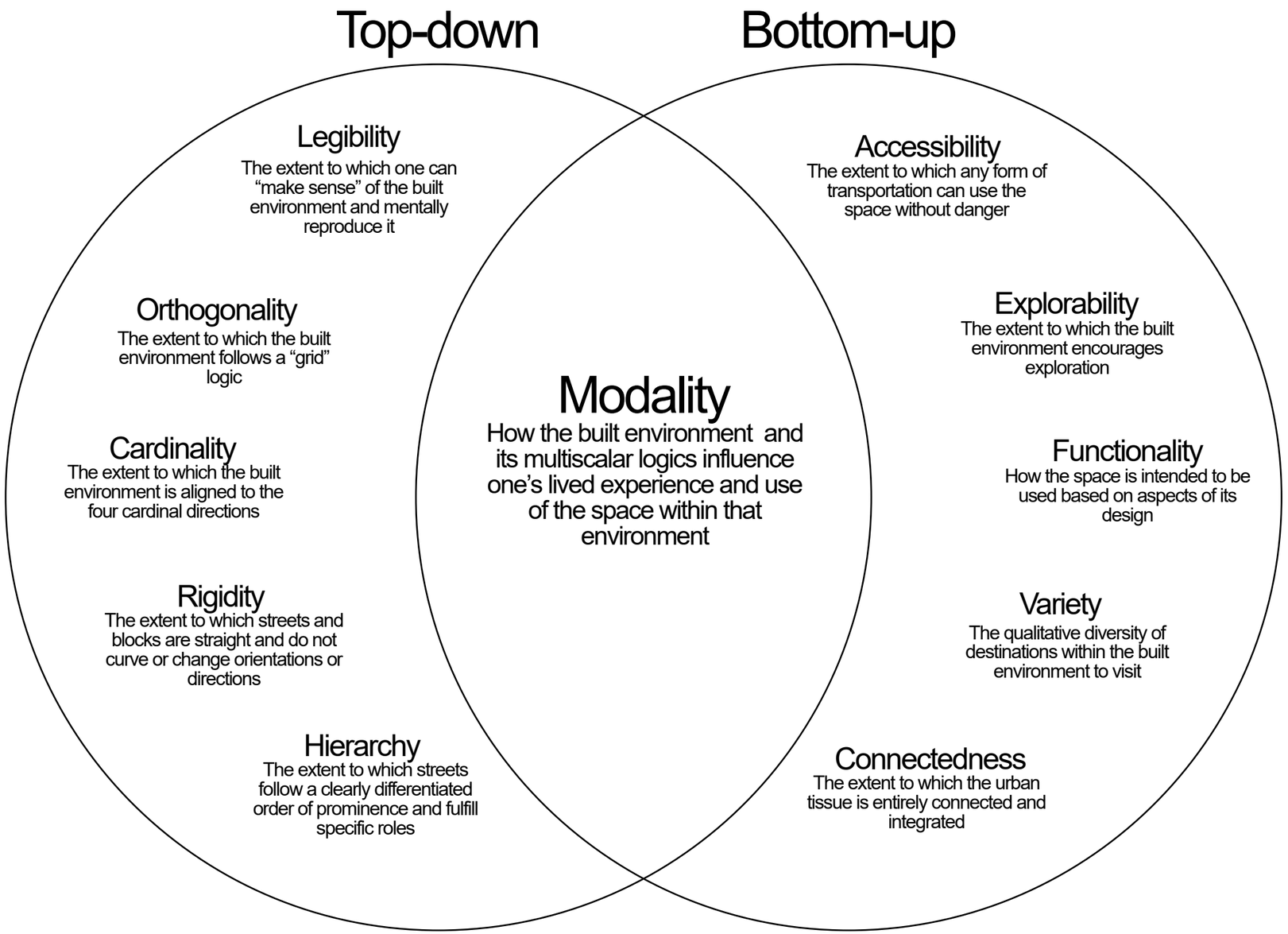
How does Chicago synthesize these two perspectives? What can Chicago teach us about accessibility and legibility?

Methodology

We will be examining one 4x4-block area of Chicago through the lens of modality. To assess modality, we will examine the study area by a series of metrics divided into two categories: Top-down and Bottom-up. We will use Top-down metrics to assess the study area holistically. For Bottom-up metrics, we will categorize the streets within the study area into different typologies and examine each typology by those metrics. Additionally, for each street typology, we will construct cross-sections and assess how the form of the streetscape influences three main modalities of walking, biking, and driving. This diagrammatic assessment of modalities will inform our analysis of the typologies using Bottom-up metrics.

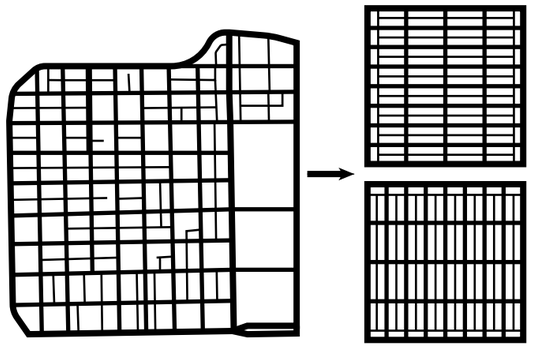
Then, we will give additional consideration to people's movement patterns within the study area and how temporality can influence modality. Furthermore, we will highlight minor design aspects of urban form which can have considerable impacts on those modalities. Finally, we will synthesize insights from all these assessments to understand how Chicago's built form shapes people's lived experiences.

Concepts



“The Cell”

The unit of analysis for this assessment will be one Chicago city “cell” - a 4x4-block unit, 0.25 mi², square box delineated by major streets. In Chicago, the city grid is comprised almost entirely of these “cells” such that a bird’s eye view of Chicago’s streets resembles a spreadsheet that diffuses into nebulous sprawl to its west and squishes against the lakeshore to its east. Even the Loop itself, despite not fitting within the system of cells comprising the rest of the city, resembles a cell.



Loop “cellular” form

Standard cell layouts

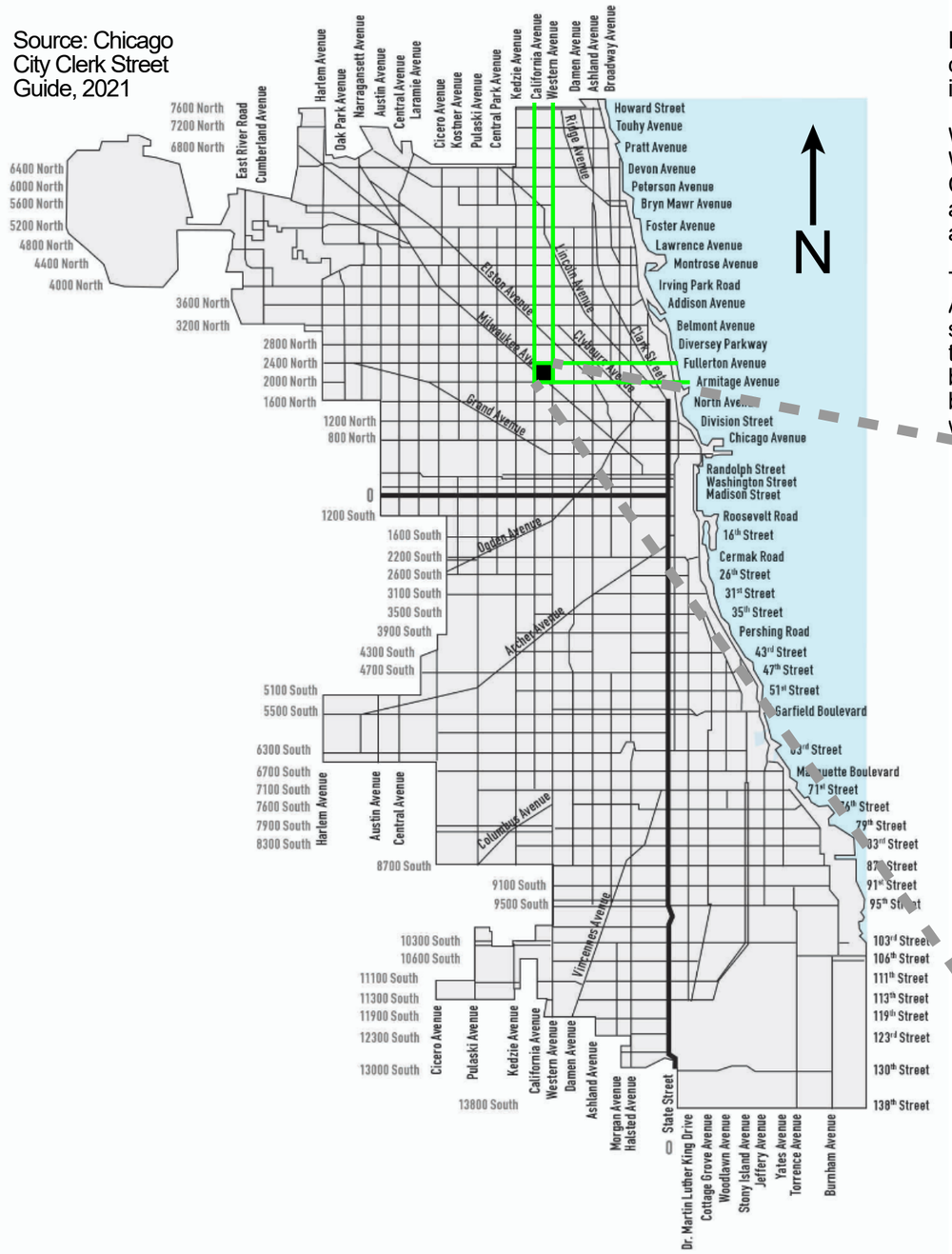
In Chicago, one block is delineated by an increment of 100 in address number. Blocks are one eighth of a mile. Major streets are spaced four blocks apart, or 400 in address number, or half a mile. Increments of 800 in block number represent one mile. Address numbers start at zero and radiate out from the center of the Loop, with north-south streets diverging from Madison Street and east-west streets diverging from State Street.

Someone standing at the intersection of Fullerton Avenue and California Avenue would see they are at the intersection of the 2400 N block and the 2800 W block, and thus they would be exactly 3 miles north and 3.5 miles west of the heart of the city (2400/800 = 3; 2800/800 = 3.5).

Cells closer to the lakeshore and the Loop are often less structurally intact, but cells at the edges of the city are often not compact enough to function as a cell.

Cells are not the same as neighborhoods; they are building blocks of neighborhoods. Multiple cells can comprise a neighborhood, but cells can also be split into two neighborhoods, especially if railroads, parks, or expressways abut the cell’s structure.

Source: Chicago City Clerk Street Guide, 2021

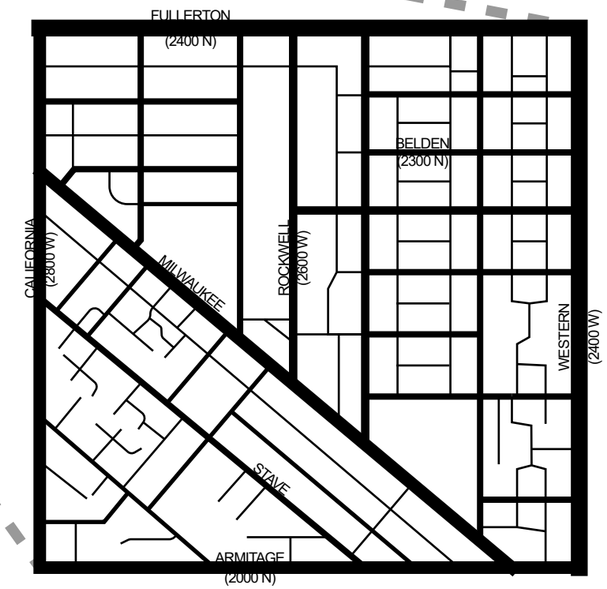


Selecting a cell

For our analysis, we want a representative cell; one that is not too compact as in those near the lakeshore, but not too low-density as in those at the edge of the city.

We will examine the cell enclosed by Fullerton Avenue to the north, Western Avenue to the east, Armitage Avenue to the south, and California Avenue to the west, in the Logan Square community area. This cell contains addresses between 2000 and 2400 North, and 2400 and 2800 West.

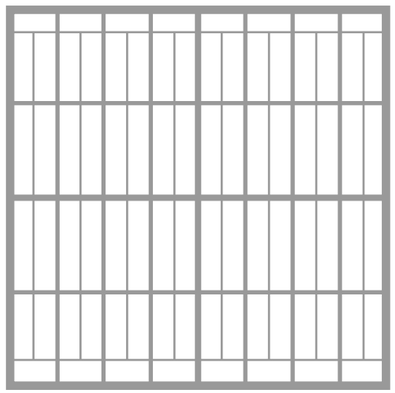
This cell is unique in that it contains a diagonal street (Milwaukee Avenue) that cuts through the overarching grid system and superimposes its own street logic on a portion of the cell. It is not too dense and not too diffuse. It contains a CTA rail line, a protected bikeway, and many bus routes. The cell also has an abundance of businesses on its commercial corridors as well as two schools within its boundaries.



Top-down: Overarching logics

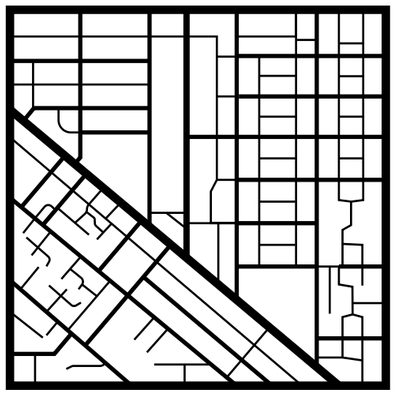
Our cell scores moderately overall in terms of top-down logics of urban form. This chaos axis places it in reference to other Chicago cells that are either overall less chaotic (more legible, orthogonal, cardinal, rigid, and hierarchical) or more chaotic (less legible, orthogonal, cardinal, rigid, and hierarchical).

59th-63rd
Kedzie-California

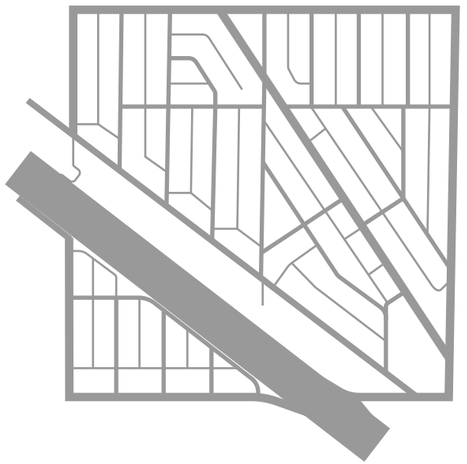


North-Division
Kostner-Pulaski

Fullerton-Armitage
California-Western



Bryn Mawr-Foster
Austin-Central



Diversey-Fullerton
Halsted-Sheridan

STRONG
Legibility
Orthogonality
Cardinality
Rigidity
Hierarchy

MIXED
Legibility
Orthogonality
Cardinality
Rigidity
Hierarchy

UNDEFINED
Legibility
Orthogonality
Cardinality
Rigidity
Hierarchy

Chaos axis

1

Blocks are packed like sardines and follow same shape, size, and orientation. Little to no deviation from the cardinal grid logic. Hierarchy of streets is simple. No diagonals.

2

Blocks are mostly equivalent in size throughout the cell, with some different shapes. Simple mix of orientations of sub-blocks. Street hierarchy remains simple. Minor deviation from the cardinal grid logic with one diagonal.

3

Blocks are fairly equivalent in shape throughout the cell, but tend to be either shorter or longer than normal, with some variation in shape. More varied mix of orientations. Hierarchy fairly simple, but sub-blocks become nebulous in places. Major diagonal which disrupts the cardinal grid logic.

4

Blocks have wide range of lengths and shapes. Varied mix of block orientations. Large expressway perforates the grid, enforcing new logics and disrupting the urban fabric. More confusing street hierarchy. Multiple diagonal streets. Cell not fully enclosed.

5

Blocks are all different shapes, sizes, lengths, and orientations. Presence of curved streets eschews cardinal grid logic. Street hierarchy is unclear except for the main diagonal, which is not completely straight and enforces perpendicularity of cross streets which ignore cardinality.

Legibility

+ This cell fits nicely within the overarching cell grid framework.
- Milwaukee Avenue can make legibility difficult, especially for streets perpendicular or parallel to it, since these streets create intersections with strange angles with properly cardinal streets.

Orthogonality

+ Almost the entirety of this cell follows a grid system, even if the grid is oriented differently in certain parts.
- In a few fringe spaces, the orthogonality of the street grid appear a bit unclear, though this is mainly because of spaces where two different orientations blend together, and most prominent only in alleyways and residential streets.

Cardinality

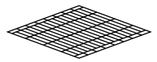
+ The portion of the cell north of Milwaukee Avenue exemplifies cardinality perfectly.
- The portion of the cell south of Milwaukee Avenue, about one third of the cell, is perpendicular or parallel to Milwaukee Avenue, rather than the cardinal directions.

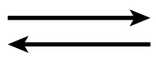
Rigidity

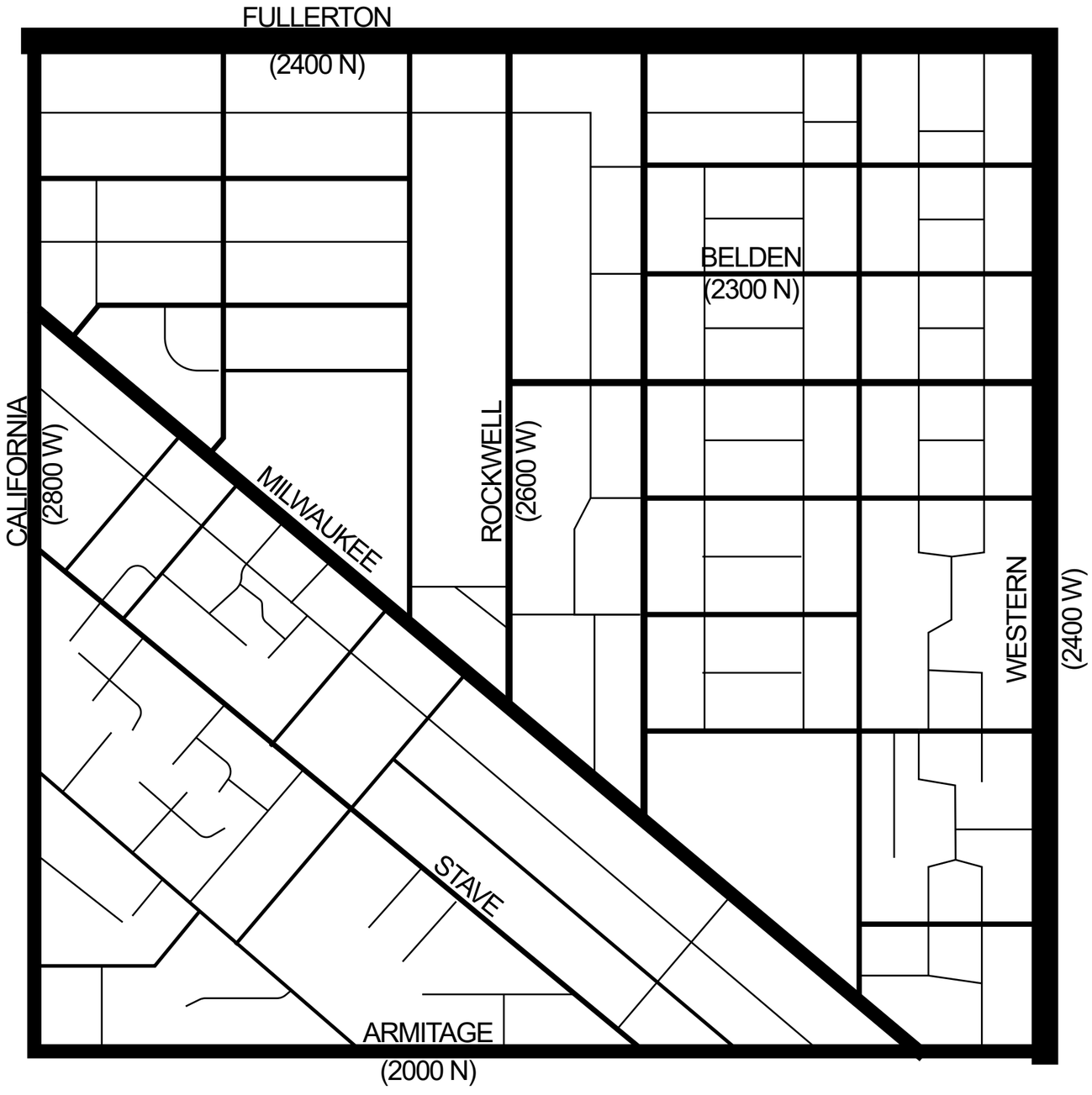
+ This cell is extremely rigid, with no turns or curves in streets.
- Some minor alleyways meander in very slight, almost negligible ways.

Hierarchy

+ Streets in this cell are notably hierarchical, with cell boundary streets and Milwaukee Avenue being two-way streets at the highest capacity, residential one-way streets at lowest capacity, and alleys being the narrowest corridors with the lowest capacity.
+ Each type of street has its own function and design idiosyncrasies.
- In areas with high concentrations of alleys, hierarchy becomes a little unclear, but this is negligible.







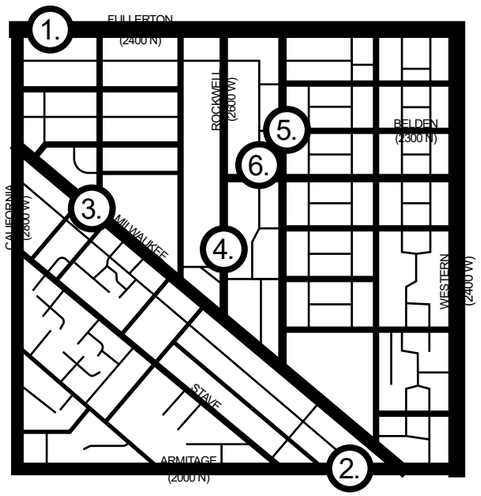
Bottom-up: Street typologies

Modality

Walking
Biking
Driving

Comfortable
Feasible

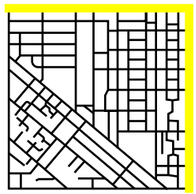
Each color underwriting the cross-section diagrams of these street typologies indicates the spaces where each of these modalities is comfortable (darker colors) or feasible for the average person (lighter colors).

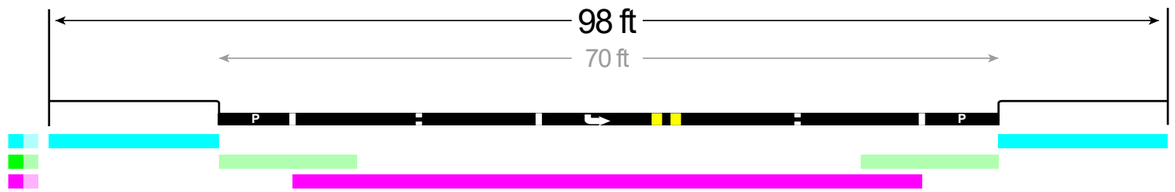


There are 6 distinct street typologies within our cell: 1) the impassable moat, 2) the porous moat, 3) the magnetic diagonal, 4) the residential stream, 5) the residential feeder, and 6) the alleyway. Each typology enforces its own hierarchy of modalities, and each typology scores differently when assessed by Bottom-up metrics.

1. Impassable Moat

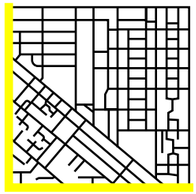
Fullerton Avenue and Western Avenue

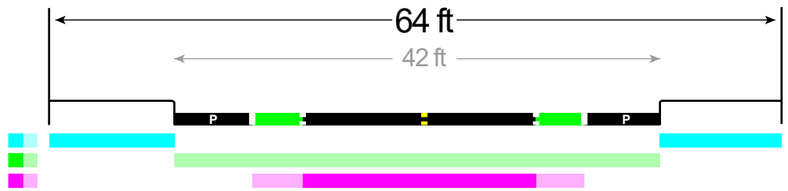




2. Porous Moat

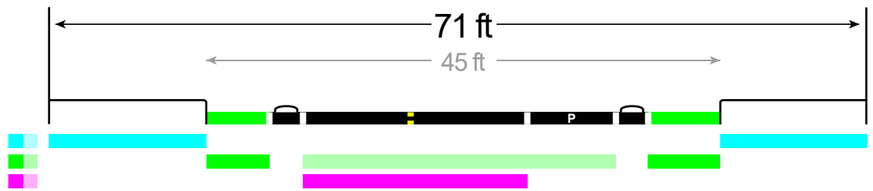
California Avenue and Armitage Avenue





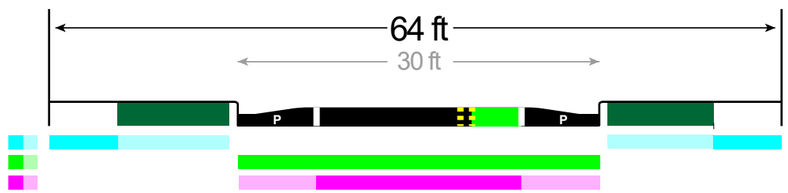
3. Magnetic Diagonal

Milwaukee Avenue



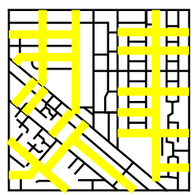
4. Residential Stream

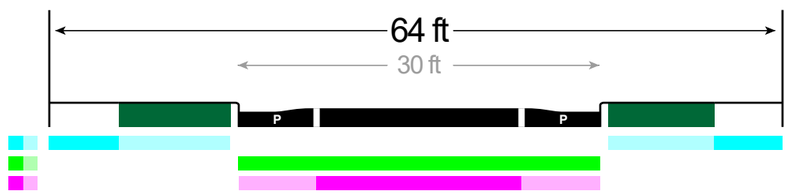
Rockwell Avenue, Maplewood Avenue, Lyndale Avenue, and Stave Street



5. Residential Feeder

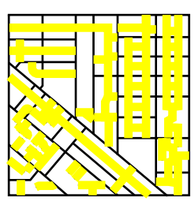
Many streets, e.g. Belden Avenue, Palmer Street, Francis Place, North Point Street, Medill Avenue, Campbell Avenue, etc.

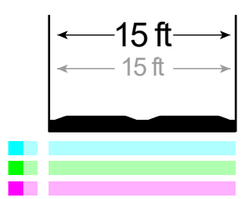




6. Alleyway

Many examples, unnamed





Bottom-up metric assessment

The six street typologies within our cell show different strengths and weaknesses in terms of bottom-up metrics of modality. Most typologies scored well on functionality, but poorly on connectedness and explorability. Accessibility and variety were mixed. Moat streets were not accessible whereas lower-order streets were more accessible, while higher-order streets showed more indicators of variety compared to lower-order corridors. Alleyways were the only typologies found to be explorable and connected on account of their general comfort and safety and their situation within the urban tissue.

1.

Wide roadway at the edge of the cell that can accommodate upwards of four lanes of vehicle traffic. Automobile traffic moves at high speeds. Few crosswalks. Only possible to safely cross at stoplights when traffic is stopped. No comfortable space for bikes; sidewalks are for pedestrians and vehicles on the roadway are moving too fast.

2.

Wide roadway at the edge of the cell that can accommodate upwards of two lanes of vehicle traffic. Automobile traffic moves at moderately high speeds. More crosswalks. Presence of painted bike lanes encourages more modalities of transportation, but only passively.

3.

Wide roadway that can accommodate upwards of two lanes of vehicle traffic. Transforms street grid of nearby streets to run parallel to the diagonal. Automobile traffic moves at moderately high speeds. More crosswalks. Protected bike lanes encourage more modes of transportation and higher comfort level engaging in those forms of transportation.

4.

Comfortable roadway that accommodates one lane of vehicle traffic moving in one direction. Parallel to moat or diagonal streets. Only differentiated from residential feeders due to longer length and/or the inclusion of painted bike lanes to encourage two-way bike travel on an otherwise one-way street. Speed bumps encourage slower vehicle speeds while still accommodating other modalities.

5.

Comfortable roadway that accommodates one lane of vehicle traffic moving in one direction. Often perpendicular to residential streams. Shorter length; connects between residential streams and moats/diagonals. High intersection density and speed bumps encourage slow vehicle speeds while still accommodating other modalities.

6.

Narrow right of way that accommodates one lane of vehicle traffic. Shorter in length, connecting between residential feeders and residential streams. Slow travel is essential because of constant interfacing with higher-order streets, and various hazards discourage fast travel. Not designed for transportation modalities, but still accommodates many, though not in an engaging or efficient way.

	Can any form of transportation use the space without danger?	Is the built environment conducive to exploration?	Is it clear how the space is intended to be used based on its design?	Is there a high qualitative diversity of destinations to visit?	Is it connected and integrated nicely into the urban tissue?
	Accessibility	Explorability	Functionality	Variety	Connectedness
Impassable Moat	No	No	Yes	Yes	No
Porous Moat	No	No	Yes	Yes	No
Magnetic Diagonal	Yes	No	Yes	Yes	No*
Residential Channel	Yes	No	Yes	No	No
Residential Feeder	Yes	No	Yes	No	No
Alleyway	Yes	Yes**	No	No	Yes***

*The design of the magnetic diagonal treats bikers like drivers, not pedestrians; they are biking on the road surface instead of being elevated up to sidewalk level. Crosswalks are still at road surface level instead of at sidewalk level as well. The hierarchy is still tipped towards road users and the urban tissue still feels disconnected.
**Alleyways are explorable. There can be all sorts of interesting things to observe in alleyways, even if visually they may not be interesting. Because of their small scale, they are easy to explore.
***Alleyways always interface with pedestrian areas before they interface with streets. They accommodate all uses without enforcing any single one.

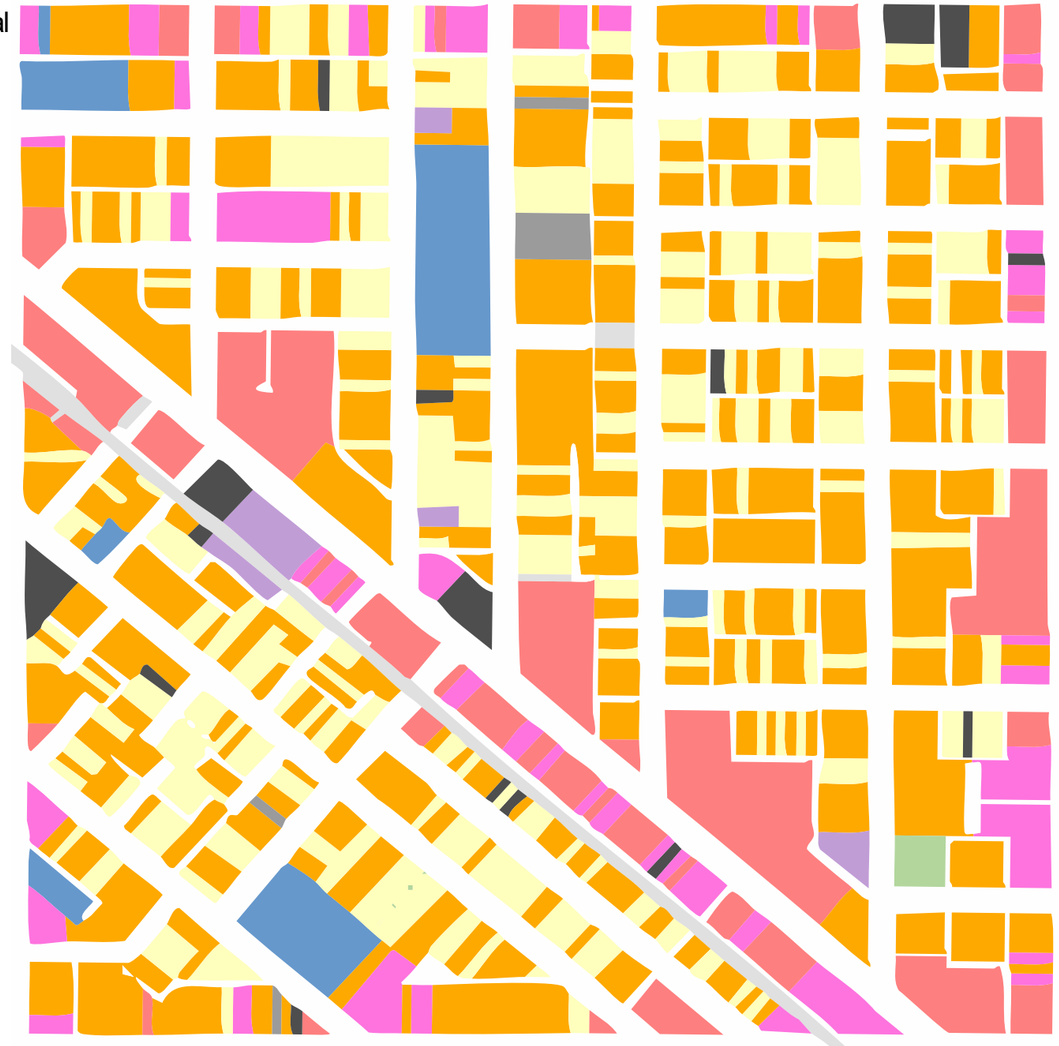
Assortment of uses

The dichotomy between the locations of residences and the locations of destinations is an important aspect of modality. The urban form in between these two locations impacts the modality of their journey. Land use patterns in any cell are thus important considerations when analyzing modality within that cell.

Most of the interior of our cell consists of residential land uses, with almost all the mixed- and commercial uses along the edges or the diagonal. There are some residential spaces along the edges and diagonal, so some people would be starting their journeys already on corridors with lots of destinations. However, someone living in the heart of the cell and someone living on an edge or diagonal would exhibit different movement patterns.

Land use

- Single-family residential
- Multi-family residential
- Commercial
- Mixed-use
- Industrial
- Institutional
- Open space
- Transportation/utilities
- Under construction
- Vacant

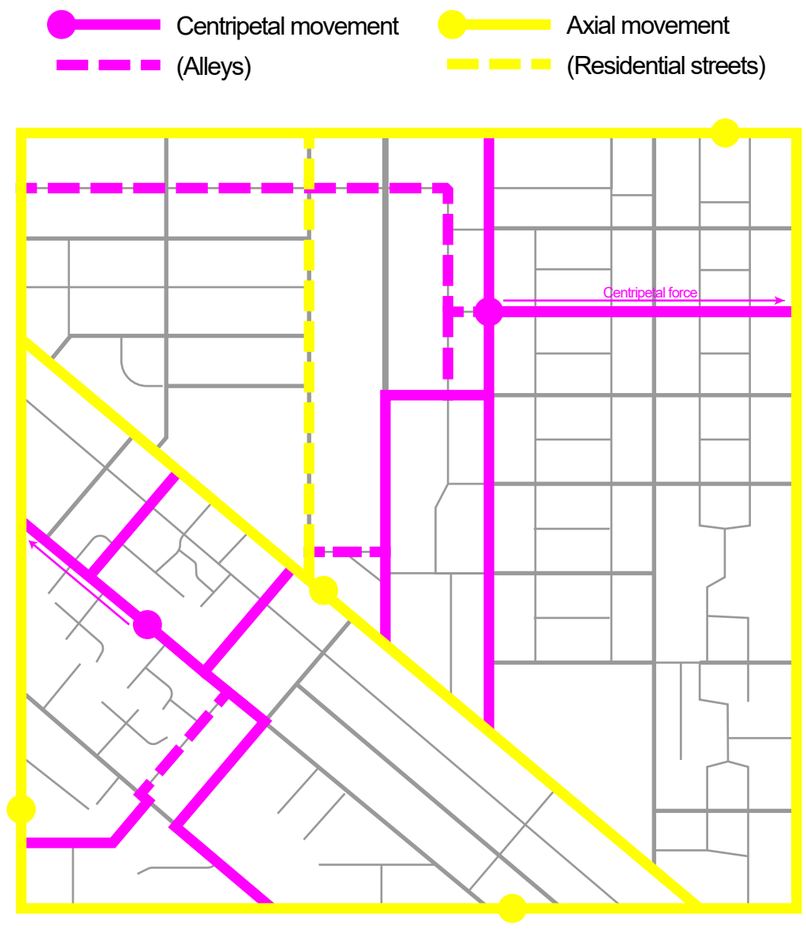


Movement patterns

Centripetal vs Axial

Because of the spatial assortment of uses, people who live on residential grid streets exhibit centripetal movement patterns. They move outward to the edges of the cell or to internal diagonal streets which create subcells when they are going to destinations. Under some circumstances, they might navigate through alleys if it's faster to do so to reach their destination, especially for pedestrians and bikers.

Individuals who live on axial or diagonal streets stay on the edges of the cell, as under most circumstances, there is no need for them to venture inward. Most destinations in any cell are alongside the cell's edge or its diagonals. Under some circumstances, they might use residential streets to reach another edge or diagonal if it's more convenient to do so.



Temporality

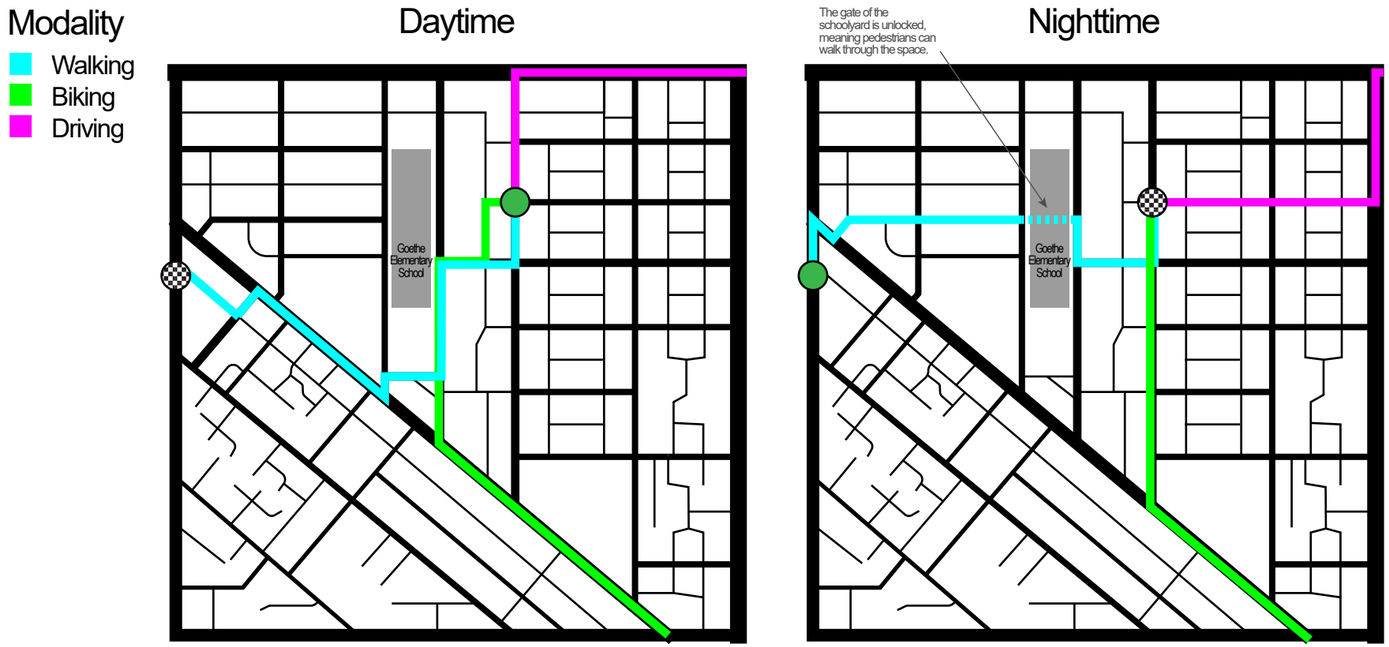
Another essential aspect of modality is temporality. The weather and the time of day can impact someone's movement through a space or the forms of mobility they choose to engage in. Temporality operates on both a top-down and bottom-up scale.

Consider a round trip from an apartment within the cell to the Loop. A pedestrian would walk to the nearest CTA station on California Avenue at the west edge of the cell. A cyclist would bike southeast towards the Loop, and a driver would drive towards the Kennedy Expressway to the east to head towards the Loop.

Walking: People may be less inclined to walk through alleyways and dark spaces during the night versus during the day. People may also be less inclined to walk in general during cold months or when it is raining.

Biking: People may be more comfortable biking on roadways at night compared to during the day because they are less busy. However, during snowy or rainy periods, people may avoid biking altogether. In the winter, alleys are not plowed, and the city is often slow to plow protected bike lanes, and this can shift bike movement patterns towards streets that are plowed.

Driving: Driving modality is inelastic; people who drive will take whatever route gets them to their destination most quickly, and time of day or year usually has little effect on this.



Design interventions

On different street typologies, different design interventions have strong influences on how those corridors score among our bottom-up metrics. We identified five examples of design interventions that improved street typologies in at least two metrics: Speedbumps, protected bike lanes, pedestrian islands, curb extensions, and fences.

Speedbumps

Found on: Residential streams, residential feeders, alleyways

What they do: Slow down driving modalities to encourage pedestrian and biking modalities by making them safer.

+Accessibility +Functionality

Protected bike lanes

Found on: Magnetic diagonal

What they do: Separate biking from driving and pedestrian modalities to encourage biking modalities

+Accessibility +Functionality

Pedestrian islands

Found on: Magnetic diagonal

What they do: Encourage walking modalities by narrowing the roadway to slow drivers and make pedestrians more visible; create better spaces for pedestrians to wait for transit.

+Accessibility +Functionality +Connectedness

Curb extensions

Found on: Where magnetic diagonal intersects with residential streams and feeders

What they do: Encourage walking modalities by slowing down drivers at intersections and making the urban fabric more connected.

+Accessibility +Explorability +Functionality +Connectedness

Fences

Found on: Residential streams, residential feeders

What they do: Create soft edges between public and private spaces that add character to pedestrian spaces and make them feel more open and inviting and less stifling.

+Explorability +Functionality +Variety +Connectedness

Conclusion

This analysis examined a 4x4 block Chicago “cell” on top-down and bottom-up aspects of urban form to identify how Chicago’s built environment can influence people’s experiences moving through it. From a top-down approach, the cell enclosed by Fullerton Avenue, Western Avenue, Armitage Avenue, and California Avenue is moderately legible, strongly orthogonal, moderately cardinal, extremely rigid, and highly hierarchical. We would expect Chicago’s built environment to be moderately easy to memorize and navigate in this cell, although some areas within the cell defy Chicago’s overarching grid logics and could introduce challenges to spatial awareness and sense of direction.

From a bottom-up perspective, our cell contains six street typologies, each of which is designed to accommodate and encourage a different slate of modalities. We identified these typologies as the impassable moat, porous moat, magnetic diagona, residential stream, residential feeder, and alleyway. Each street typology has strengths and weaknesses when examined for accessibility, explorability, functionality, variety, and connectedness. Most typologies were accessible except for the moat typologies. No typology was sufficiently explorable except for the alleyway, which was the only typology which did not score well on functionality on account of its all-accommodating yet none-enforcing design. Moats and diagonals scored well on variety because of their presence of destinations, whereas the other typologies did not. No typology scored well on connectedness except for the alleyway on account of its integration with both the sidewalk system and the street network.

Furthermore, the locations of the beginnings and ends of trips within a cell can influence how people move through it. Trips beginning on moat or diagonal streets often remain on those corridors, whereas trips beginning on residential streets move towards those corridors on account of most destinations within a cell locating along its edge or diagonals. As a result, edge and diagonal dwellers exhibit axial movement patterns, whereas people living in the heart of the cell move in centrifugal patterns.

Additional consideration was given to temporality’s influence on modality. Time of day, amount of daylight, weather, and seasons can influence how people move through Chicago’s built environment and the modality in which they engage that environment.

Finally, we enumerated five design interventions that change bottom-up perceptions of street typologies: Speedbumps, protected bike lanes, pedestrian islands, curb extensions, and fences. Each of these interventions improves a street typology on at least two bottom-up metrics.

Our neighborhood cell synthesizes many top-down logics of urban form like orthogonality, cardinality, rigidity, and hierarchy, with bottom-up lenses like accessibility, variety, and connectedness to show how these ideas overlap and how they don’t. Even though the cell contains many diverse land uses and street typologies, the overarching system containing those land uses and typologies is rigid, and a strict hierarchy divides spaces in the cell into categories and sorts them. Overall, our cell exhibits more top-down traits than bottom-up traits. We hope we have identified ways in which Chicago’s neighborhood cells can take advantage of its top-down strengths by improving its form from the bottom-up through design interventions like those we have identified.