**STRESS LEVEL CALCULATION:**

**Street Types:**

**Neighborhood Business Street (NB):**

Stress Level: 1

Stress Level: Low to Medium

Design Strategy: Prioritize low-stress bicycle facilities, favoring separated lanes or shared-use paths; ensure safe intersection designs for both pedestrians and cyclists.

**Main Street (MS):**

Stress Level: 2

Stress Level: Medium (could be high during peak hours)

Design Strategy: On priority bicycle network streets, remove parking for separated facilities; accommodate buses and low-speed vehicle traffic; accept lower LOS during peak times.

**City Connector Street (CC):**

Stress Level: 3

Stress Level: Medium

Design Strategy: Provide separated bicycle facilities, particularly if part of a priority bicycle corridor, to ensure safe and efficient cyclist connectivity across the city.

**Urban Center Street (UC) with Moderate Bicycle Priority:**

Stress Level: 4

Stress Level: Medium to High (depending on traffic and event schedules)

Design Strategy: Implement dedicated facilities where possible; consider reducing curbside space for cycling infrastructure on priority corridors.

**Program to retrieve all the street data of Kalamazoo and Portage:**

import osmnx as ox

import pandas as pd

import geopandas as gpd

def fetch\_streets\_data(places):

    # Initialize an empty GeoDataFrame to store combined street data

    all\_streets = gpd.GeoDataFrame()

    for place in places:

        # Fetch street network from OSM

        G = ox.graph\_from\_place(place, network\_type='drive')

        # Extract edges (streets) data

        edges = ox.graph\_to\_gdfs(G, nodes=False)

        # Filter out service roads

        edges = edges[edges['highway'] != 'service']

        # Extract required columns

        edges = edges[['name', 'highway', 'maxspeed', 'lanes', 'geometry']]

        # Combine with previous data

        all\_streets = gpd.GeoDataFrame(pd.concat([all\_streets, edges], ignore\_index=True))

    return all\_streets

def main():

    # Define the places (areas of interest)

    places = ["Kalamazoo, Michigan, USA", "Portage, Michigan, USA"]

    # Fetch and process the data

    streets\_data = fetch\_streets\_data(places)

    # Save to Excel

    streets\_data.to\_excel("kalamazoo\_portage\_streets\_data.xlsx", index=False)

if \_\_name\_\_ == "\_\_main\_\_":

    main()

**Safest to least safest highways for bicycles:**

**Residential Roads:** Typically have lower speed limits and less traffic, making them safer for cyclists.

**Unclassified Roads:** Depending on local conditions, these roads might be safe if they are local, low-traffic roads.

**Tertiary Roads:** Smaller roads with lower traffic volumes, potentially safer for cycling.

**Secondary Roads:** May have higher traffic volumes and speeds than tertiary roads, but could still be relatively safe, especially with cycling infrastructure.

**Trunk Roads:** Larger roads with higher traffic volumes, less ideal for cycling, but safety can be improved with dedicated cycling infrastructure.

**Primary Roads:** Similar to trunk roads, these roads can have high traffic volumes and speeds, making cycling less safe without proper infrastructure.

**Motorways:** Generally not suitable for cycling due to high-speed traffic; cycling is often prohibited on motorways.

**Tertiary Link Roads:** These roads could pose increased risks for cyclists, especially if they connect to larger roads or highways. 15 mph: Roads with a 15 mph speed limit are typically very safe for cycling, as the lower speed reduces the risk of severe accidents.

**Excel Formula to categorize the street types and provide it a score from 1 to 4:**

**=IF(OR(B2="residential", B2="unclassified", B2="tertiary"), 1,IF(B2="secondary", 2, IF(OR(B2="trunk", B2="tertiary\_link"), 3,IF(OR(B2="primary", B2="trunk\_link", B2="primary\_link"), 4, ""))))**

**Safest to least safest speed for bicycles:**

**15 mph:** Roads with a 15 mph speed limit are typically very safe for cycling, as the lower speed reduces the risk of severe accidents.

**20 mph:** Similar to 15 mph, roads with a 20 mph speed limit are generally safe for cycling and may include residential areas.

**25 mph:** Roads with a 25 mph speed limit are still relatively safe for cycling, especially in residential and urban areas.

**30 mph:** A common speed limit in urban areas, and while cycling is still generally safe, it's important to consider the volume of traffic.

**35 mph:** As speed limits increase, so does the potential risk for cyclists. Roads with a 35 mph limit may be less safe, particularly without dedicated cycling infrastructure.

**40 mph:** Higher speed limits, such as 40 mph, can pose increased risks for cyclists, especially on roads with heavier traffic.

**50 mph:** Cycling on roads with a 50 mph speed limit can be more hazardous, and dedicated cycling infrastructure becomes more crucial.

**60 mph:** Roads with a 60 mph speed limit are generally not recommended for cycling due to high-speed traffic.

**70 mph:** Highways with a 70 mph speed limit are typically unsafe for cycling, and cyclists are often prohibited on such roads due to safety concerns. Lane: Roads with a single lane in each direction are generally safer for cycling, as they typically have lower traffic volumes.

**Excel Formula to categorize the speeds and provide it a score from 1 to 4:**

**=IF(C2<=20, 1, IF(C2<=30, 2, IF(C2<=40, 3, 4)))**

**Safest to least safest lanes for bicycles:**

**1 Lane:** Roads with a single lane in each direction are generally safer for cycling, as they typically have lower traffic volumes.

**2 Lanes:** Roads with two lanes (one in each direction) can still be relatively safe for cycling, especially if traffic is moderate and there's sufficient space for cyclists.

**3 Lanes:** Roads with three lanes (one direction plus a center turn lane) may have higher traffic volumes, but they can still be navigable for cyclists, particularly with proper infrastructure.

**4 Lanes:** Roads with four lanes (two in each direction) often have higher traffic volumes, and cycling can be less safe without dedicated cycling infrastructure.

**5 Lanes:** Roads with five lanes (two in each direction plus a center turn lane) can pose increased risks for cyclists due to higher traffic volumes.

**6 Lanes:** Roads with six lanes (three in each direction) typically have high traffic volumes, making them less suitable for cycling without proper infrastructure.

**7 Lanes**: Roads with seven lanes (three in each direction plus a center turn lane) are generally not recommended for cycling without dedicated cycling paths or lanes.

**Excel Formula to categorize the lanes and provide it a score from 1 to 4:**

**=IF(D2=1, 1, IF(D2=2, 2, IF(OR(D2=3, D2=5), 3,IF(OR(D2=4, D2=6, D2=7), 4, ""))))**

**Retrieving Amenity Data for Kalamazoo and Portage:**

[out:json][timeout:25];

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// cafe

node["amenity"="cafe"](42.2272, -85.6500, 42.3245, -85.4820); // Kalamazoo

node["amenity"="cafe"](42.1600, -85.6500, 42.2416, -85.5206); // Portage

// fast\_food

node["amenity"="fast\_food"](42.2272, -85.6500, 42.3245, -85.4820); // Kalamazoo

node["amenity"="fast\_food"](42.1600, -85.6500, 42.2416, -85.5206); // Portage

node["amenity"="biergarten"](42.2272, -85.6500, 42.3245, -85.4820); // Kalamazoo

node["amenity"="biergarten"](42.1600, -85.6500, 42.2416, -85.5206); // Portage

node["amenity"="canteen"](42.2272, -85.6500, 42.3245, -85.4820); // Kalamazoo

node["amenity"="canteen"](42.1600, -85.6500, 42.2416, -85.5206); // Portage

node["shop"="restaurant"](42.2272, -85.6500, 42.3245, -85.4820); // Kalamazoo

node["shop"="restaurant"](42.1600, -85.6500, 42.2416, -85.5206); // Portage

// pub

node["amenity"="pub"](42.2272, -85.6500, 42.3245, -85.4820); // Kalamazoo

node["amenity"="pub"](42.1600, -85.6500, 42.2416, -85.5206); // Portage

// bar

node["amenity"="bar"](42.2272, -85.6500, 42.3245, -85.4820); // Kalamazoo

node["amenity"="bar"](42.1600, -85.6500, 42.2416, -85.5206); // Portage

// bakery

node["shop"="bakery"](42.2272, -85.6500, 42.3245, -85.4820); // Kalamazoo

node["shop"="bakery"](42.1600, -85.6500, 42.2416, -85.5206); // Portage

// ice\_cream

node["amenity"="ice\_cream"](42.2272, -85.6500, 42.3245, -85.4820); // Kalamazoo

node["amenity"="ice\_cream"](42.1600, -85.6500, 42.2416, -85.5206); // Portage

// food\_court

node["amenity"="food\_court"](42.2272, -85.6500, 42.3245, -85.4820); // Kalamazoo

node["amenity"="food\_court"](42.1600, -85.6500, 42.2416, -85.5206); // Portage

//drinking water

node["amenity"="drinking\_water"](42.2272, -85.6500, 42.3245, -85.4820); // Kalamazoo

node["amenity"="drinking\_water"](42.1600, -85.6500, 42.2416, -85.5206); // Portage

// Restrooms

node["amenity"="toilets"](42.2272, -85.6500, 42.3245, -85.4820); // Kalamazoo

node["amenity"="toilets"](42.1600, -85.6500, 42.2416, -85.5206); // Portage

// Bike Repair Shops

node["amenity"="bicycle\_repair\_station"](42.2272, -85.6500, 42.3245, -85.4820); // Kalamazoo

node["amenity"="bicycle\_repair\_station"](42.1600, -85.6500, 42.2416, -85.5206); // Portage

// Bike Racks

node["amenity"="bicycle\_parking"](42.2272, -85.6500, 42.3245, -85.4820); // Kalamazoo

node["amenity"="bicycle\_parking"](42.1600, -85.6500, 42.2416, -85.5206); // Portage

);

out body;

>;

out skel qt;