How accessible is our campus to bicycles? How quickly can we travel from our dorms to other buildings on a bike? Much time does it take to bike from class to class, thus building to building? How fast can we walk to the nearest bike room?

Motivated by these questions, my project evaluates campus accessibility to bicyclists. With hundreds of bikes on campus, it is important to see if our campus’ path and road "network" allow bicyclists to get from place to place efficiently. Not forgetting our school’s commitment to sustainability and environmental activism, I want know if our campus accommodates student bicyclists, and faculty and staff bicycle commuters. My project is therefore of interest to Middlebury’s Environmental Council, which works to evaluate transportation patterns on campus and to promote bicycling, ride-sharing, and the use of public transportation in the Middlebury community. Using maps of Middlebury’s paths, roads and building locations (Fig. 1), I ran a network analysis in ArcGIS10 to find bicycling times between dorms and non-residential buildings and times between non-residential buildings and other non-residential buildings. I also estimated walking times from dorms to bike rooms and shower facilities to places of work.

Building a network in GIS

To generate my results, I performed a network analysis in ArcMap10 that calculated travel times between buildings. Travel times were noted on movement exclusively with the Middlebury path and road network, and on the temporal “costs” found at each stage of that network.

To understand "cost," think about biking between buildings as a script. You (1) leave your dorm, find and unlock your bike (2) you bike to your destination (3) lock your bike and enter the building. Each stage of the script takes time. Biking time on a path or road depends on your speed and the length of your ride. I estimated that the average ride per hour on one travels on a bike is 12. By dividing each path’s length by this speed limit, I determined the time (in seconds) it would “cost” a bicyclist to travel on each path or road. Locking and unlocking a bike should take 15 to 20 seconds. Rounding that bike racks are found within 20 meters of building entrances, I estimated that within a 20 meter buffer of entrance a rider receives a "cost" of 15 to 20 seconds. Crossing a crosswalk “costs” a rider at most 4 seconds. Each step of the network therefore has a temporal "cost" in seconds. With these "costs" in place, ArcGIS can generate travel time by accumulating "costs" necessary to travel between buildings.

Walking requires a much simpler script, with fewer costs: leaving a building, walking to your destination and entering a building. In my walking network, each path has a speed limit of 2 mph, and the seconds "cost" of each path or road depends on its length. Crosswalks again received a "cost" of 4 seconds.

Building accessibility by averaged travel times

Fig. 2 shows the average bicycle travel time from a specified dorm to any other non-residential building on campus. Travel times from the dorm to all non-residential buildings are shown. The graph is a representation of the bicycle network. The data is based on the number of trips. Fig. 3 found averaged travel times between non-residential buildings and other non-residential buildings. The data gives us a sense of which dorms and buildings are well-connected or isolate on campus.

Bike rooms

Fig. 3: from non-residential buildings to other non-residential buildings

To understand biking between non-residential buildings. I also estimated walking times from dorms to bike rooms and shower facilities to places of work.

Fig. 2: from dorms to non-residential buildings

What does it mean?

My analysis shows that campus is fairly accessible to students with bicycles. Every building is at greatest a 6 minute ride from a dorm. All dorms are at greatest a 5 minute walk from a main bike room on campus. Predictably, later stands out at the "most accessible dorm on campus," whereas the Melges and the Vokes House are the least accessible by bike. Again, the Service Building is predictably the most accessible building when traveling between non-residential buildings (with Old Chapel second), and the Memorial Field House is the least accessible with an average travel time of 4.5 minutes by bike.

For faculty and staff bicyclists and commuters, campus is moderately accommodating. This judgment is based on the walking times from shower facilities to places of work, which demonstrates that all buildings are within a 10 minute walk of a shower. Freshening up before work is optimal for bike commuters. According to criteria established by the American League of Bicyclists, a business “bike friendliness” can be evaluated by employees access to showers and storage lockers.

Accessibility to showers however is only one factor to accommodation. The number of available showers in a building (Old Chapel has one available shower) limits its use, especially if many faculty or staff would like to shower around the same hour in the morning. Lookers where faculty can store clothes also play into accommodation. However distribution of services on campus is a variable that this analysis does not consider.

Other error in this analysis lies firstly in my choice of "costs" times. I may use "costs" based on personal experiences and did not use proper scientific method in my choices. Second, environmental factors such as slope were omitted from my analysis, therefore the network is flat.

Yet, ground-testing these result by timing my own biking and walking around campus proves my results are valid. Although not exact, both my networks have generated approximate results, and therefore deliver a fairly accurate assessment of bicycle accessibility and accommodation on Middlebury’s campus.

facilities accessibility (walking maps)