Rethinking Parking Requirement Exemptions with Spontaneous Accessibility

Public Transit Analytics (https://publictransitanalytics.com)

Parking requirements for new residential buildings mitigate the impacts of development for neighbors with a preexisting dependence on street parking. These requirements, however, also lower the friction of bringing new cars into the area, causing congestion and environmental impact. For this combination of reasons, new construction is exempted from providing parking if it is likely that new residents can rely on transit to meet their needs. In Seattle, new buildings within a reasonable distance of frequent transit can opt out of providing parking. The definition of frequency has recently come under scrutiny for its ambiguity. This is an opportunity, however, to use a more nuanced and precise mechanism for determining eligibility for exemptions. Spontaneous Accessibility, a concept that measures the ability of individuals to make unexpected trips, is well-suited for this task and should be considered as the law's language is being rethought.

A New Measurement

Exempting a new development from providing parking occurs when it is likely that those making use of it will not need to own a car. Without the ability to know this in advance, it is projected using the quality of transit service in the area. In Seattle, Director's Rule 6-2015 (City of Seattle Department of Planning & Development, 2015) provides the specific process for measuring this quality, and thus whether a development site needs parking. One or more stops within $\frac{1}{4}$ of a mile of the site must have combined bus headways, in the same direction of travel, of at least 15 minutes for at least 12 hours per day six days per week and at least 30 minutes for 18 hours per day every day. This is a manual process with a standard worksheet.

This approach has several limitations that make it imprecise for fulfilling its purpose of identifying "where transit service is adequate to serve commute and non-work related trips" (City of Seattle Department of Planning & Development, 2015). The measurement treats all stops within $\frac{1}{4}$ of a mile as equally valuable and all sops outside as providing no benefit. In reality, the distance to stops impacts the value in some proportional way. It also assumes any frequent transit stop is equally valuable, regardless of how effectively the lines serving it allow a range of trips. Furthermore, by considering walking distance rather than time, it fails to account for geographic obstacles like hills. On top of that, there is not an automated way of making the calculation, resulting in a measurement that takes manual effort to compute and captures only a very simplified view of the quality of transit at a location.

Spontaneous Accessibility quantifies the ability to make unexpected, unanticipated trips. Accessibility-based measurements focus on the ability of individuals to fulfill their needs using the transit network (Hanson, 2004). Spontaneous Accessibility is a particularly useful accessibility measurement for evaluating parking requirement exemptions. Rather than focusing on common trips, such as a daily commute, Spontaneous Accessibility considers trips to arbitrary end points and at any time of day, capturing the full intent of the purpose stated in Director's Rule 6-2015.

The process of measuring Spontaneous Accessibility starts by dividing the area under study into a set of non-overlapping, uniformly-sized Sectors. A duration is selected to serve as an isochrone threshold; this is the longest time that an individual will allocate for a trip. With these parameters selected, different types of measurements can be performed. To evaluate the Spontaneous Accessibility of a single point, such as a development site, an algorithm repeatedly determines which Sectors can be reached within the duration by walking and taking transit, for every minute of the day. This process uses full transit schedules and models walks to and between transit stops, as well as from stops to arbitrary Sectors, with accurate walking paths. The Point Accessibility Ratio of a location is calculated by summing the reached Sector counts for each starting time and dividing it by the hypothetical maximum reachability. This calculation is shown in Equation 1, where s_0 is the starting location, T is the set of all time samples, S is the set of Sectors, and $reached$ is a function that computes the number of Sectors reached in the duration for a starting point and starting time. This calculation can be extended to measure the entirety of a region, rather

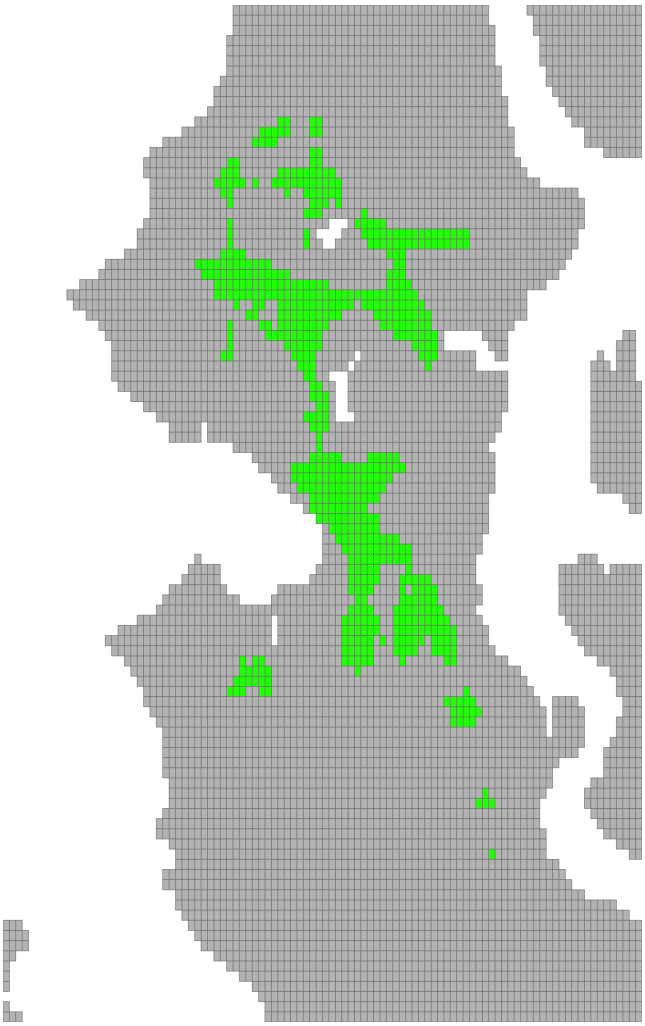

Figure 1: *Sectors exceeding 90th percentile Point Accessibility.*

than choosing a single point, by making the calculation at the center of every Sector and combining the counts for each starting point. This measurement, called the Network Accessibility Ratio, is shown in Equation 2.

$$PAR_{duration} = \frac{\sum_{t \in T} reached(t, s_0)}{|T| \cdot |S|} \quad (1)$$

$$NAR_{duration} = \frac{\sum_{t \in T} \sum_{s \in S} reached(t, s)}{|T| \cdot |S|^2} \quad (2)$$

Though very different in form, Spontaneous Accessibility measurements and the process in Director's Rule 6-2015 have a similar goal: they attempt to evaluate whether life without a private vehicle is practical. Spontaneous Accessibility, however, more accurately portrays the value that the transit network is providing, by incorporating details beyond headway.

How to Use It

Point Accessibility and Network Accessibility are measured as dimensionless ratios, but whether a development must provide parking is a yes-or-no decision. Several techniques can be used to transform these measurements into a decision-making framework. Most simply, it is possible for the municipality to choose the isochrone time, have developers compute the Point Accessibility Ratio for the site, and allow a parking exemption only if a threshold set by the municipality is met. To ensure that the threshold makes sense, the municipality can first calculate the Network Accessibility Ratio for its entirety. This calculation also produces the Point Accessibility Ratios for every Sector within it. With that information, the municipality can look at the distribution of Point Accessibility Ratios and define a threshold based on order statistics, such as mandating that only development sites with a Point Accessibility Ratio above the 90th percentile of all ratios may be exempted. Crafting the law in this way prevents the need for legislative action as transit service changes. To simplify the process for developers, parking can be exempted for all development sites within a Sector, provided that the Sector is above a threshold or percentile. A map of Seattle showing the Sectors that have a Point Accessibility Ratio above the 90th percentile, for a 30-minute isochrone, is shown in Figure 1.

No matter which approach is chosen, computing any Spontaneous Accessibility measurement requires few resources: schedules in General Transit Feed Specification (GTFS) format, OpenStreetMap road data, and optionally, geographic survey data of bodies of water. It is computed with an open source software tool, making calculation both automatic and transparent. The ability of Spontaneous Accessibility to simplify calculation, while simultaneously providing a more precise view of whether new developments have access to quality transit, make it a compelling choice for use in Seattle's next generation of parking requirement exemption legislation.

References

City of Seattle Department of Planning & Development (2015). *Director's Rule 6-2015*. `http://www.seattle.gov/dpd/LUIB/AttachmentProjectID63082015.02.23%20DDR2015-6.pdf`.

Hanson, Susan (2004). "The Context of Urban Travel Concepts and Recent Trends". In: *The Geography of Urban Transportation*. Ed. by Susan Hanson and Genevieve Giuliano. 3rd ed. New York, NY: Guilford Press, pp. 3–29.