2009 Bicycle Parking Assessment

University of Colorado at Boulder
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Background

In 2008, the bicycle program (jointly managed between Parking & Transportation Services and the Environmental Center) created an MOU to renovate and expand parking on campus. For the first two years of the MOU a rack utilization approach was used to determine parking need. Any bicycle lot with use higher than 75% was flagged for expansion. In addition, those lots that may not have had usage over 75% but did contain out-dated racks were flagged for renovation. Bicycle program staff realized, after conducting the 2008 parking census that the presence of errata was most likely due to inefficient lot locations rather than just an insufficient capacity of racks. Further, in the spring of 2009, staff conducted another census to substantiate this.

This assessment discusses the capacity and efficiency of parking at individual building destinations (entrances).

Process

1. Inventory and map building entrances
2. Determine parking capacity and errata
3. Identify entrances with parking need based on over utilization or significant errata
4. Generate level I recommendations for planning group

Building Entrances

Because of the large size of many buildings on campus, this assessment uses individual building entrances to evaluate parking capacity. In the spring of 2009, staff surveyed each building on the Main Campus, East Campus and Williams Village campus and identified their entrances. Further, staff estimated if an entrance was two-way (public or "usable") or otherwise (service or access restricted). The assessment within this document is on two-way ("in-out") entrances only. A total of 1,451 building entrances were identified and mapped. Each entrance is assigned a unique ID, and associated with a building code.

Bicycle Parking Capacity & Errata

Staff conducted a bicycle census in the spring of 2009 to confirm existing parking capacity and placement, count bicycles at racks, identify and count bicycles not parked at racks, or "errata". Errata bicycles are identified as not parked in a rack and are often locked to hand rails, sign-posts, trees, benches, etc. or may not be locked at all. Contiguous errata bicycles were marked as one site; separate sites were identified when one bicycle length or more separated them.

Data for building entrances is separated into two categories: within 200' and within 50' of the entrance. According to the Victoria Transport Policy Institute and other organizations[1], bicycle planners recommend placing parking within 50' of an entrance for maximum effectiveness. However, many parking locations on campus are beyond 50' of any entrance, and thus a 200' radius was used for analyzing all-campus data. Beyond 200', parking and errata were not analyzed due to

[1] Victoria Transport Policy Institute, www.vtpi.org. Dero Bike Rack Company, www.dero.com.

lack of relevance to specific building entrances. There are 3,645 parking spaces (39% of total supply) within 50' of building entrances and 4,385 spaces (46% of total supply) between 50' and 200'. There remains 1,403 parking spaces beyond 200' (15% of total supply).

The distance between the centroid of a parking lot and an entrance, or between errata (single point) and an entrance is calculated using GIS software.

A total of 6014 bicycles were parked on campus in April, 2009. Of those, 479 were identified as errata. In total there are 9433 parking spaces on campus in 1159 racks across campus.

For the whole campus, the average distance between parking and an entrance is 124 feet.

Table 1: Entrances with highest lot capacity

Door ID	Building Code	Count of LOT Sites within Radius of Door	Count of ERRATA Sites within Radius of Door	Max Count of Bicycles	Max Count of ERRATA Bicycles	**Capacity of Lots**	Max Average Utilization	Max Count of Bicycles over Total Capacity	Max Count of Bicycles over Optimal Use	Rack Recommendation (using CORA-10 Standard)
Within 50' of entrance										
733	KTCH	2	0	120.0	0.0	**191.0**	63%	-71.0	-23.3	-9.5
1441	ECME	1	0	93.0	0.0	**170.0**	55%	-77.0	-34.5	-10.3
1440	ECME	1	0	93.0	0.0	**140.0**	66%	-47.0	-12.0	-6.3
888	CHEY	1	0	65.0	0.0	**132.0**	49%	-67.0	-34.0	-8.9
Within 200' of entrance										
807	RAMY	5	0	29.5	0.0	**149.0**	20%	-119.4	-82.2	-11.0
83	BCAPB	6	0	24.0	0.0	**81.3**	29%	-57.4	-37.1	-4.9
858	STRN	3	1	34.4	0.4	**65.5**	53%	-30.7	-14.3	-1.9
859	STRN	3	1	34.4	0.4	**65.5**	53%	-30.7	-14.3	-1.9
860	STRN	3	1	34.4	0.4	**65.5**	53%	-30.7	-14.3	-1.9
Notes on the table: Within 50', the entrance at Ketchum (Door ID 733 above) has the highest capacity at 191 parking spaces. Other entrances such as those at Atlas and Ramaley are near to this capacity but still beyond the 50' area of analysis. When the analysis area is expanded to 200' this same Ketchum entrance has the following statistics:										
733	KTCH	5	4	22.0	1.6	**35.1**	63%	-11.5	-2.8	-0.4

Summary of differences between 50' and 200' areas

The area within 50' represents a more focused set of data, showing higher capacities. With a broader area of analysis (200'), these numbers are more diffuse, with lower overall capacities.

Overutilization & Significant Errata

With the campus-standard CORA-10 rack, optimal utilization is estimated to be between 65 and 75%. Based on staff observation, utilization above 75% often results in a rack appearing full and the presence of bicycles locked to alternatives. Similarly, utilization below 65% results in the rack appearing empty, with ample capacity for bicycles. Within the 65% and 75% range, staff observed that a rack appeared to have a significant number of bicycles while maintaining open space for a marginal number of bicycles.

Significant errata sites are identified as those with more than one bicycle. Similarly based on staff observation, for example, a single bicycle locked to a signpost is very common, and may not be based on behavioral trend or inadequate capacity. However, once two or more bicycles are locked to the same signpost or handrail, bicyclists may begin to identify the site as "suitable" for parking (representing a behavioral trend) or bicyclists may be responding to an inadequate capacity near to their destination point.

Table 2: Entrances with no lot capacity and highest count of errata

Door ID	Building Code	Count of LOT Sites within Radius of Door	Count of ERRATA Sites within Radius of Door	Max Count of Bicycles	**Max Count of ERRATA Bicycles**	**Capacity of Lots**	Max Average Utilization	Max Count of Bicycles over Total Capacity	Max Count of Bicycles over Optimal Use	Rack Recommendation (using CORA-10 Standard)
Within 50' of entrance										
1278	CICC	0	4	0.0	**51.0**	**0.0**		51.0	51.0	6.8
965	ANDS	0	1	0.0	**43.0**	**0.0**		43.0	43.0	5.7
736	ENVD	0	3	0.0	**16.0**	**0.0**		16.0	16.0	2.1
307	MUEN	0	3	0.0	**12.0**	**0.0**		12.0	12.0	1.6
Within 200' of entrance										
687	THTR	0	4	0.0	**4.0**	**0.0**		4.0	4.0	0.5
739	TCOM	0	8	0.0	**3.6**	**0.0**		3.6	3.6	0.5
294	HLMS	0	5	0.0	**3.5**	**0.0**		3.5	3.5	0.5
193	EPRK	0	7	0.0	**3.3**	**0.0**		3.3	3.3	0.4
Notes on the table: the entrances presented here are some of the highest visibility, commonly acknowledged locations for their abundance of errata: College Inn, Environmental Design, Hellems. Looking at the top site for within 50' (College Inn, door 1278), it has the following statistics for within 200':										
1278	CICC	4	17	4.3	**4.9**	**6.4**	68%	2.8	4.4	0.6

Table 3: Entrances with lot capacity and highest count of errata

Door ID	Building Code	Count of LOT Sites within Radius of Door	Count of ERRATA Sites within Radius of Door	Max Count of Bicycles	**Max Count of ERRATA Bicycles**	**Capacity of Lots**	Max Average Utilization	Max Count of Bicycles over Total Capacity	Max Count of Bicycles over Optimal Use	Rack Recommendation (using CORA-10 Standard)
Within 50' of entrance										
910	BUCK	1	2	4.5	**6.0**	**3.5**	129%	7.0	7.9	0.9
911	BUCK	2	2	18.0	**6.0**	**17.5**	103%	6.5	10.9	0.9
1374	TB97	1	2	0.0	**4.5**	**2.0**	0%	2.5	3.0	0.3
734	KTCH	1	1	13.0	**3.0**	**20.0**	65%	-4.0	1.0	-0.5
Within 200' of entrance										
1323	ATHN	3	16	4.4	**5.4**	**4.1**	108%	5.7	6.7	0.9
1328	ATHN	4	16	5.2	**5.4**	**5.3**	97%	5.2	6.5	0.9

1020	LIBY	3	14	21.5	**5.0**	**24.9**	86%	1.6	7.9	1.0
1025	LIBY	3	17	13.1	**4.9**	**13.9**	94%	4.1	7.5	1.0
Notes on the table: these entrances, while showing some parking capacity, continue to show errata count. In contrast to table 2 above, these entrances require a closer look to understand why the errata persists. In the first case, Buckingham (door 910 above) has over utilized parking capacity and no extra capacity exists for the errata bicycles. For comparison, TB97 (door 1374 above) shows capacity but–likely for behavioral reasons–bicyclists continue to lock their bicycles elsewhere–causing errata.										
910	BUCK	7	3	21.5	**2.3**	**19.4**	111%	4.3	9.2	1.2

Table 4: Entrances with highest average utilization

Door ID	Building Code	Count of LOT Sites within Radius of Door	Count of ERRATA Sites within Radius of Door	Max Count of Bicycles	Max Count of ERRATA Bicycles	Capacity of Lots	**Max Average Utilization**	Max Count of Bicycles over Total Capacity	Max Count of Bicycles over Optimal Use	Rack Recommendation (using CORA-10 Standard)
Within 50’ of entrance										
1327	ATHN	1	1	15.0	3.0	10.0	**150%**	8.0	10.5	1.1
1293	MRCTG	1	0	1.5	0.0	1.0	**150%**	0.5	0.8	0.1
265	HLET	1	1	82.0	2.0	56.0	**146%**	28.0	42.0	3.7
149	NTCT2S	1	1	1.9	0.2	1.3	**144%**	0.8	1.1	0.1
Within 200’ of entrance										
1265	TB87	1	5	1.7	1.2	1.1	**150%**	1.8	2.0	0.3
916	BUCK	4	3	11.4	2.3	8.6	**133%**	5.1	7.2	1.0
169	MUS	3	0	10.0	0.0	7.7	**130%**	2.3	4.2	0.6
170	MUS	3	0	10.0	0.0	7.7	**130%**	2.3	4.2	0.6
Notes on the table: above, overutilization is represented irrespective of the parking capacity. In the examples above, the door at Athens (ID 1327) has a relatively high capacity, but an even higher relative count of bicycles. Contrastingly the door at Marine Court G (ID 1293) has a relatively low capacity but still too many bicycles for this capacity. In comparison, the Athens door is increased by one order of magnitude, yet the utilization rate remains the same. For reference, the top record for within 50’ is included below when the area of analysis is expanded to 200’. When the analysis area is expanded to 200’ this same Athens entrance has the following statistics:										
1327	ATHN	3	12	4.4	2.1	4.1	**108%**	2.5	3.5	0.5

Table 5: Entrances with no utilization or errata

Door ID	Building Code	Count of LOT Sites within Radius of Door	Count of ERRATA Sites within Radius of Door	Max Count of Bicycles	**Max Count of ERRATA Bicycles**	Capacity of Lots	**Max Average Utilization**	Max Count of Bicycles over Total Capacity	Max Count of Bicycles over Optimal Use	Rack Recommendation (using CORA-10 Standard)
Within 50’ of entrance										
1357	IBS7	1	0	0.0	**0.0**	5.0	**0%**	-5.0	-3.8	-0.7
1361	PFDC	1	0	0.0	**0.0**	5.0	**0%**	-5.0	-3.8	-0.7
1375	IBS6	1	0	0.0	**0.0**	5.0	**0%**	-5.0	-3.8	-0.7
244	ARMR	1	0	0.0	**0.0**	7.5	**0%**	-7.5	-5.6	-1.0
246	ARMR	1	0	0.0	**0.0**	7.5	**0%**	-7.5	-5.6	-1.0

1410	USW	1	0	0.0	**0.0**	8.0	**0%**	-8.0	-6.0	-1.1
695	MCOL	1	0	0.0	**0.0**	9.0	**0%**	-9.0	-6.8	-1.2
Within 200' of entrance										
1376	ARMT	1	0	0.0	**0.0**	1.0	**0%**	-1.0	-0.8	-0.1
Notes on the table: there are seven entrances with unused parking capacity–approximately 47 spaces–and no errata within 50'; there is one entrance with unused parking capacity–approximately one space–and no errata within 200'.										

Summary of differences between 50' and 200' areas

When looking at errata counts, tables 2 and 3 re-sort when expanding the analysis area to 200'. Specifically, some entrances, which at 50' had high errata counts, when analyzed at 200' must share this count more widely. Other entrances, which at 50' had relatively lower errata counts, encompass new errata counts at 200'.

Similarly, in Table 4, utilization is not necessarily lower within a 200' analysis area when compared with a 50' area. As the analysis area expands, a given entrance's capacity may be shared with other entrances and new capacities may be encompassed in the wider analysis area. Thus, the resulting calculations may yield a different collection of entrances with overutilization.

Table 5 demonstrates that within the 50' analysis area, there are seven entrances with no utilization (unused capacity); as expected, when the analysis area expands to 200', there are fewer entrances that show no utilization across all capacity within the analysis area.

Level I Recommendations

The analysis presents the data in a per-door format, as the most precise option for assessing the parking need at destination points. As a result, parking capacity and bicycle counts are divided proportionally across entrances. For example, if a single rack has five entrances within 50' of it, those five entrances must share its capacity. Thus, each door has a proportional capacity of 1/5 rack. Furthermore, the estimation of needed parking capacity is based on a target utilization of 75%, not 100%. Thus, if there are 15 bicycles that need to be parked, 2 10-space racks are necessary.

Table 6: Entrances with most racks recommended

Door ID	Building Code	Count of LOT Sites within Radius of Door	Count of ERRATA Sites within Radius of Door	Max Count of Bicycles	Max Count of ERRATA Bicycles	Capacity of Lots	Max Average Utilization	Max Count of Bicycles over Total Capacity	Max Count of Bicycles over Optimal Use	**Rack Recommendation (using CORA-10 Standard)**
Within 50' of entrance										
1278	CICC	0	4	0.0	51.0	0.0		51.0	51.0	**6.8**
965	ANDS	0	1	0.0	43.0	0.0		43.0	43.0	**5.7**
265	HLET	1	1	82.0	2.0	56.0	146%	28.0	42.0	**3.7**
736	ENVD	0	3	0.0	16.0	0.0		16.0	16.0	**2.1**
307	MUEN	0	3	0.0	12.0	0.0		12.0	12.0	**1.6**
913	BUCK	3	1	41.0	1.0	32.0	128%	10.0	18.0	**1.3**
1025	LIBY	0	1	0.0	10.0	0.0		10.0	10.0	**1.3**

912	BUCK	4	1	54.5	1.0	46.0	118%	9.5	21.0	**1.3**
Within 200' of entrance										
909	BUCK	9	5	21.9	3.1	17.2	127%	7.8	12.1	**1.6**
914	BUCK	7	6	21.5	3.3	19.4	111%	5.4	10.3	**1.4**
912	BUCK	7	5	21.5	2.8	19.4	111%	4.9	9.7	**1.3**
913	BUCK	6	5	19.8	2.8	17.6	112%	5.0	9.4	**1.3**
910	BUCK	7	3	21.5	2.3	19.4	111%	4.3	9.2	**1.2**
911	BUCK	7	3	21.5	2.3	19.4	111%	4.3	9.2	**1.2**
947	KITT	6	2	12.7	4.3	10.9	116%	6.1	8.8	**1.2**
915	BUCK	5	4	17.9	2.7	15.8	113%	4.8	8.7	**1.2**

Practical Applications, Next Steps

The application of the recommendations from above is largely left up to the planners and facilities managers for the campus. However, it is quickly apparent in the recommendations that collections of selected entrances are necessary to comprise a single parking improvement project (e.g., 1.5 racks + 1.5 racks = one 3-rack site). Thus, this section discusses some possibilities for looking at this data.

First, the data can be collected for individual buildings. For example, Buckingham appears often in the sample tables above; if all of the entrances for Buckingham are looked at together, it presents a wider perspective on a potential improvement for the building.

Second, geographical constraints may determine the data collection. That is, one might use GIS analysis to determine a collection of entrances with established need as discussed above, calculating the total rack recommendation within a desired proximity.

Finally, at the simplest level, site improvements could be hand-selected based on the factors the tables discuss above. Those improvements once implemented can be reintegrated into the analysis upon the next iteration, and a further selection of improvements may be made at that time. This is essentially a "try and see" approach, which may be more practical given the operational constraints of universities.[2]

[2] A similar approach to this is how planners at the University of Washington improve their bicycle parking system (Celeste Gilman, Transportation Systems Manager, 206-685-4380).