# Flexible Bike Parking: New Ways of Thinking Bicycle Racks

*Magdalena Bürbaumer, Christian Zeitelhofer, Martin Berger, Christoph Wöss, Karlheinz Gürtl, Paul Brugner, Gosia Stawecka*

(DI Magdalena Bürbaumer MEng, Vienna University of Technology, Karlsgasse 11, 1040 Wien, magdalena.buerbaumer@tuwien.ac.at)
(DI Christian Zeitelhofer, Vienna University of Technology, Karlsgasse 11, 1040 Wien, christian.zeitelhofer@tuwien.ac.at)
(Univ.Prof. Dipl.-Ing. Dr.-Ing. Martin Berger, Vienna University of Technology, Karlsgasse 11, 1040 Wien, martin.kp.berger@tuwien.ac.at)
(Ing. Christoph Wöss, INNOVAMETALL Stahl- & Metallbau GmbH, Zamenhofstraße 19, 4020 Linz, c.woess@innovametall.at)
(Gosia Stawecka MSc, StadtLABOR Innovationen für urbane Lebensqualität GmbH, Griesgasse 40, 8020 Graz, gosia.stawecka@stadtlaborgraz.at)
(Paul Brugner, BEd MSc, StadtLABOR Innovationen für urbane Lebensqualität GmbH, Griesgasse 40, 8020 Graz, paul.brugner@stadtlaborgraz.at)
(Karlheinz Gürtl, MA, StadtLABOR Innovationen für urbane Lebensqualität GmbH, Griesgasse 40, 8020 Graz, karlheinz.guertl@stadtlaborgraz.at)

## 1 ABSTRACT

With the steadily increasing number of cyclists in Austrian urban agglomerations over the past decade, the gaps and deficiencies in the cycling infrastructure also becomes more visible, especially parking problems with bicycles. The DrückMichi project focuses on an expansion of the usage of existing car parking lots on streets towards an equal access for bicycles.

Therefore, an idea competition was organized in spring 2020; the general public was invited to submit their ideas, which resulted in a multitude of approaches and ways to conceptualize flexible bicycle racks. A new type of bike rack – which is flexible in its usage as it can be pulled into the parking space whenever needed – enables bicycles to be parked on car parking lots, primarily dominated by motorized vehicles. The outcome of the contest shows that bicycle racks can be thought and designed differently to the classic, omnipresent models such as the Wiener Bügel. This paper provides an overview of some of the submitted ideas of the competition and thus aspires to inspire and motivate to rethink bicycle parking.

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Keywords: climate neutrality, shared parking spaces , bicycle rack, flexible bike parking, mobility

## 2 INTRODUCTION AND THEORETICAL FRAMEWORK

A sustained boom in cycling over the past decade is particularly evident in urban agglomerations (BMVIT 2017) and underlines necessary redistribution of space and usage accessibility. Some counting stations, i.e., in Vienna, even showed record values in 2020, when cycling was besides walking one of the healthiest and safest means of transport for a wide range of individual necessary journeys during the corona crisis (Radlobby 2021). What is more, only a third of the Viennese street area is intended for walking and cycling, two thirds of the area are lanes for motor vehicle traffic. However, the share of active mobility in daily trips is 33 percent, that of car trips is only 29 percent (MA23 2018, Wiener Linien 2018).

The moderately developed cycling infrastructure can in many cases not keep up with this growing demand. It is often described as poor or incomplete, especially when it comes to bicycle parking (ORF 2020). Amongst various other aspects, the availability and quality of parking spaces has a major impact on the use of a vehicle, including bicycles (Aldred et al. 2013: p. 613). Nevertheless, bicycle parking tends to be forgotten when discussing cycling infrastructure (Heinen and Buehler 2019). In the Austrian city of Graz for example, there were 6,000 public bicycle racks in 2013 – the citizens though owned around 150,000 bicycles at the same time (Kozina 2018: 23). Especially in inner-city areas (e.g., in historically shaped Gründerzeit-style districts) the shortage is greatest and the alternatives due to urban planning conditions (such as limited space, properties with a mezzanine floor or a lack of barrier-free access, few cellars or courtyard areas etc.) are rare. In Graz and Vienna, i.e., it can be observed that more and more bicycles are parked informally, for example on road signs and house walls (Kozina 2018: p. 23, ORF 2020). Simultaneously, there are more and more discussions about a reorganization of the urban street space to create a more equitable allocation of space for non-motorized activities. The transport policy guideline 2020 of Graz, i.e., states that sustainable modes of transport should have long-term consistent priority over motorized individual transport by for example


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increasing the availability of parking spaces for bicycles by 500 new racks annually (Stadt Graz 2015: p.15, bicy.it 2011, Kozina 2018: 24)

In Austria, bicycles can be legally parked on sidewalks, assumed the sidewalks are at least 2.5 meters wide and bikes do not hinder pedestrians (§68 Abs 4 StVO) which is often not the case, i.e. in Vienna >40% of the sidewalks are smaller than 2m (Österreichischer Verkehrssicherheitsfonds 2011, Open Data 2016). In regard to the corona pandemic and the necessary compliance with the minimum distances on the often-narrow sidewalks, it is important to improve bicycle parking infrastructure apart from the sidewalks. At present, according to the Austrian traffic regulations, bicycles can be parked on parking spaces (§23ff StVO); it needs to be ensured, though, that parked bicycles cannot fall (§68 Abs 4 StVO). It is questionable whether this can be achieved with a kick stand alone. A lack of awareness and a lack of protection against theft are further obstacles for cyclists to use parking lots. In a survey in spring 2020, over 60% from 545 interrogated Austrians think that parking bicycles in parking lots is not allowed (Zeitelhofer 2020). In the opinion of the research team, a respective infrastructure is needed to make parking lots usable for safe bicycle parking that is in accordance with the legal framework (this though is not necessary for tricycle cargo bikes for example, which are stable by their way of construction).

At the same time a flexible bicycle rack turns a monofunctional parking space into a multifunctional one, with benefits in terms of daily, seasonal or weather-related fluctuations in the choice of the means of transportation. This also applies to places affected by recurring fluctuations as for example at schools, outdoor swimming pools and street spaces with mixed use. A flexible bicycle rack further might facilitate the reorganization of the urban space and grant greater shares to active forms of mobility. A dual usage possibility can be a door opener for decision-makers to smoothly transition the use of space without preferring one type of transport. This project also aims to raise awareness for an equal use of parking spaces between cyclists and motorists. Now the question is, how should a bike rack look like to be able to meet all of these requirements. Today there are already numerous design variants of bicycle parking systems but the majority, however, permanently occupies an area due to permanent installation. Approaches to a flexible or temporary use of the scarce public inner-city space can be found relatively sparse, such as from Bergs (2017).

## 3 METHOD

In order to obtain the technical expertise and possible further creative contributions for the flexible approach, a user inclusion was pursued through an idea competition. The objectives were set as competitions on the so-called “Open-Innovation-Platform”, operated by the Mobility Lab Graz.[1] The number of submissions per participant was not limited. The contest was launched in spring 2020 and was endowed with € 1000 for the main prize, € 700 and € 400 for second and third place. The first ranked idea was then constructed – the focus of this paper, though, is to show the diversity and variety of all the submitted ideas.

The project consortium defined minimum requirements for all submissions before they are allowed to be evaluated by the jury. Bonus points could also be achieved with nice-to-have criteria which resulted from technical standards. Normally, the criteria for bicycle parking facilities vary depending on the location. However, general demands can be placed on bicycle parking systems: According to the common recommendations, bike racks should have at least one leaning option, ideally also a front wheel holder. On the one hand, this provides secure standing (even when loaded with a child) and, on the other hand, increased protection against theft. A pure front wheel mount should not be considered (Radlobby Wien 2017). All in all, the aim of the call was that the bracket must allow flexible use of the parking lot.

| | |
|---|---|
| • Stability of the bike (also with child) | • Minimum height when unfolded of 700mm |
| • When unused or when folded, it must be possible to drive over the bike rack (max. height when folded up 110mm) | • The construction or mechanism must be evident from a technical sketch or a detailed plan |
| • The opening mechanism must not be triggered unintentionally | • Observe the parking lot dimensions of 2m wide and 5m long |
| • Damping device or weight damping to avoid uncontrolled falling to the ground | • At least the bicycle frame or frame and front wheel can be locked to the bike rack |

Table 1: Minimum requirements for the general assesment admittance. Source: own representation.

[1] https://mobilitylabgraz.neurovation.net/node/308242 [German only]

| | |
|---|---|
| • Wheel bracket should be self-explanatory | • Little effort required for the (release) mechanism |
| • Hardly or no costly special manufactures | • Low-maintenance construction |
| • Mechanical or digital counter can be included | |

Table 2: Nice-to-Have-Requi-Criteria for bonus points. Source: own representation.

In addition to its online presence, the competition was also actively advertised by directly contacting the following Austrian and also some German institutions through written and verbal activation: More than 73 higher vocational schools, technical colleges and universities with a focus on product development, industrial design, mechanical engineering and technical hobbyists. After the extended submission period has expired, the applicants could rate the ideas of other applicants (except for their own idea): two submitted ideas were randomly presented and the user could select his or her preferred idea. The user rating would be particularly suitable as a preselection if there were a large number of submitted ideas. Since the number of submitted ideas was manageable, an interdisciplinary jury of experts with practical relevance (consisting of two construction engineers from Innovametall GmbH, a civil engineering professor from TU Wien and an engineering student from BOKU University) were able to rate each submission individually. The ideas were rated by using a considered set of weighted criteria in the categories maturity of the idea, road safety, ability to lock the bicycle, compatibility in the street space, usability, production costs and durability. The final ranking then developed within a qualitative discussion of the submissions.

## 4 RESULTS

Fortunately, the idea competition brought a creative range of professional submissions. 22 actors ultimately took part with different technical and design approaches. Out of all the ideas, 15 met the minimum requirements. The submissions ranged from sketchy ideasdrawn sketches to professionally executed construction plans and can be assigned to two categories: leaning bars and front wheel holders. All ideas had an individual trigger mechanism, locking functions, mostly also included different suspension and locking systems. The spectrum of constructions extends from simple bollards with a rotating mechanism, to ones with a double joint, sliding and folding system or pure pulling mechanisms. Some submissions consist of triangular legs and pollards with tilting, rotating and folding mechanisms. The category of pure front wheel brackets shows different trigger mechanisms by turning and pulling handles or by pushing the front wheel of the bicycle or by a foot pedal or a combination of these elements. Most of the submitted bike rackets are intended for installation on the parking lot surface or on the edge of the roadway, but a few also below the surface of the road or within the curb.

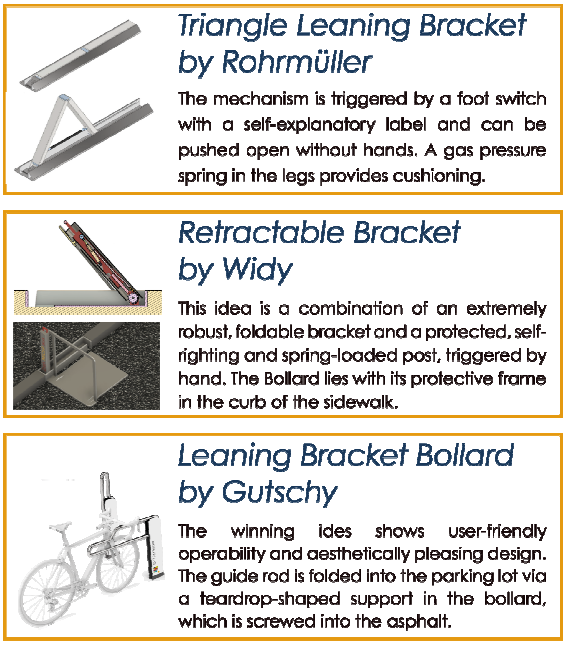


Fig. 1: Three examples from the competition. Source: own representation.

Ten ideas ultimately proved to be feasible by the jury. Since the evaluation criteria contained certain deficiencies or were not applicable to all ideas in the course of the evaluation, a qualitative assessment of the ideas was also carried out by the jury. Based on


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their practical experience, once again all the advantages were compared with the expected disadvantages. Many of the ideas fulfilled, e.g., the required flexible usage options, in particular the creation of a flat surface when not in use. In the further assessment, however, some would be difficult to construct and implement in terms of their components or mechanism. Some designs turned out to be too filigree and unstable, containing many moving parts and highly precision mechanics, which could not guarantee an expected longevity, functionality and protection against vandalism and theft. A simple way of installation was another evaluation criteria in order not to exceed the financial limits of the time-limited research project and to ensure that the bicycle rack would be attractive to municipalities due to its cost-efficiency. The jury favored mechanisms or modes of operation that enable anchoring in the ground without disproportionate effort (such as breaking up the asphalt). It was also most important that the folding mechanism could not be triggered unintentionally, for example by being run over by a car or walking over it. To be on the safe side, the jury preference was for wheel brackets that are located to the side of the road and enable safe and controlled folding, swinging, turning etc.

| Idea Code | Storage Type | Construction | Operating Mode | Triggered by | Suspension / Weight Decay | Flat Surface when Unused | Useability | Production Costs | Idea Maturity | Follow-Up Potential |
|---|---|---|---|---|---|---|---|---|---|---|
| A | Leaning Bracket | Bollard with Bar | Pulling + Swieveling | Hand | Rubber Layer | No | High | Low | High | High |
| B | Leaning Bracket | Bollard with Bar | Pulling + Folding | Hand | Pneumatic Spring | Yes | Moderate | Moderate | High | High |
| C | Wheel Holder | Bar in Depression | Teetering | Front Wheel | No/Not Necessary | Yes | High | Moderate | High | High |
| D | Wheel Holder | Bar in Depression | Folding | Foot | Spring + Cable | Yes | Low | High | High | Low |
| E | Leaning Bracket | Triangular Bars | Folding | Hand | Rubber Layer | Yes | Low | Moderate | High | Low |
| F | Leaning Bracket | Triangular Bars | Folding | Hand | No/Not Necessary | Yes | Low | High | Moderate | Moderate |
| G | Leaning Bracket | Bollard with Bar | Pulling + Swieveling | Hand | No/Not Necessary | No | Moderate | Low | High | Low |
| H | Leaning Bracket | Bar in Depression | Teetering | Hand | No/Not Necessary | Yes | Low | Moderate | High | Low |
| I | Leaning Bracket | Bar on Ground | Pushing + Folding | Foot | Spring | Yes | Low | Moderate | Moderate | Low |
| J | Wheel Holder | Bar in Depression | Folding | Front Wheel | No/Not Necessary | Yes | Low | Moderate | Moderate | Low |
| K | Leaning Bracket | Bollard with Bar | Folding | Hand | No/Not Necessary | No | Moderate | Moderate | Low | Moderate |
| L | Leaning Bracket | Sheet on Ground | Folding | Foot + Hand | Neopren Bearings | Yes | Moderate | Moderate | High | High |
| M | Leaning Bracket | Triangular Bars | Folding | Foot | Pneumatic Spring | Yes | Low | Moderate | Moderate | High |
| N | Leaning Bracket | Bar on Ground | Folding | Foot | Pneumatic Spring | Yes | Moderate | High | High | Low |
| O | Leaning Bracket | Bollard with Bar | Folding | Foot + Hand | Dual Disc Spring | Yes | Moderate | Low | High | Low |

Table 3: Overview of individual technical and evaluation aspects of the 15 ideas that met the minimum requirements. A total of 12 leaning bars and 3 front wheel holders were submitted. Seven of them are operated by hand, 4 with the foot and two each with hand and foot or the front wheel. The usability results from a point system for "self-explanatory functionality of the mechanism", "easy implementation of the folding mechanism", "avoiding hand use" and "little effort required to trigger the mechanism". The column production costs are calculated from the costs of the components and the assembly. Certain ideas are suitable for following up the plans or still require revision or post-processing in certain aspects. Source: own representation.

Fig. 2: The DrückMichi prototype being tested at a parking lot at the hospital in Graz. Source: own representation.

This outcome primarily shows that bicycle racks can be designed differently to the classic, omnipresent models such as the “Wiener Bügel”. The winning ideas impress with their simplicity in use with a simple mechanism and optics and also meet all technical requirements and are also inexpensive to manufacture and

install. Therefore, in the opinion of the jury, a classic front wheel holder in the sidewalk edge was also counted to the top three inventions, even though it should actually no longer be used in public spaces according to the latest technical cycling recommendations. The now constructed and tested prototype is produced by the consortium partner innovametall GmbH based, on the competition outcome. The first produced foldable wheel bracket consists of a vertical bollard with a rotating disc mechanism, from which the guide bar or the leaning bracket can be pulled out into the parking lot without great effort. It is therefore mounted on the edge of the road or on the edge of the sidewalk and only requires minimally invasive installation. Due to the small area required by the bollard of just a few square centimetres, there are several installation options that are also suitable for niche areas. The DrückMichi is now being tested at the Holding Graz car park for material behaviour and first user experiences under real conditions.

## 5 DISCUSSION

The idea competition offers a creative range of technical approaches in flexible bicycle parking systems. Five out of 15 technical approaches would be suitable for further development under certain conditions (higher financial resources, human resources, liability issues, ...). Working with virtual platforms enables new ways of working with creative and specialized staff outside of your own project boundaries. This selective inclusion of people is intended to reduce the organization's management effort. The competition combines specific tasks with the appropriate skills of the users who become active independently through incentive mechanisms. Their results were made available to the project team as commons free of charge or were compensated for in terms of prices. This instrument creates a paradoxical principle: an individualized form of organization in which individuality plays a major role, but hardly the individual as such – only their contribution to the platform (Al-Ani et al. 2015). From a social science perspective, it would be interesting to ask the participants about their intrinsic motivation and expectations, how they found out about the competition and how they experienced the evaluation process. This could possibly provide information, among other things, that different prices or specifications, payment guarantees if the minimum requirements are met, etc. could lead to a different submission quota, changes to the qualitative or quantitative planning content, shifts in the gender distribution or to improvements to the platform itself.

Although numerous ideas come close to the original idea of a retractable or foldable wheel bracket in or on the asphalt, there are limits to the implementation and manufacture of creativity. The DrückMichi-prototype that has now been produced cannot fully disappear when unused. – Which means that when the bar is folded in, a bollard remains on the edge of the road or sidewalk. Improvements would have to result in a flat surface when the wheel bracket is not used. For this purpose, the prototype can be further developed, so the bollard can also be folded and laid down. Likewise, in the case of non-occupancy by a bike, a self-regulating extension of use could be achieved by automatically folding up the bracket. Nevertheless, in Austria it is a first attempt to make parking spaces more equally usable for cyclists.

As planners we do have an influence on stimulating certain tendencies of usages. Whether the folding bike racks bring an improvement or a deterioration in the flexibility of the use of space and promoting active mobility, cannot be answered out of a theoretical context. This also applies to what extent the used model proves to be practicable, whether it leads to greater acceptance or use. In order to be able to achieve well-founded statements, the new racks would have to be tested in public streets under appropriate conditions.

## 6 CONCLUSION

The ideas competition was able to prove that there is a wide range of creative ideas. One submitted idea has already been registered as a patent. The current prototype does not yet represent the solution for flexible bike parking in public space, but further developments and adjustments of the prototype (e.g., by disappearing at ground level when unoccupied) could certainly promote flexibility and dynamism for space utilization. In the DrückMichi case, which uses the first-come first-serve approach, authorities try to avoid possible conflict situations, even if they may not even occur in practice as first surveys on private ground showed. Furthermore, missing legal bases in the Road Traffic Regulations for allowing an experimental use in public street space complicate the development of new creative innovations in this field.

Flexible, shared parking spaces for bicycles and motorized vehicles address some of the most urgent mobility-related challenges in urban settings: (1) Smartness: the flexible mode of the bicycle rack enables a dynamic and efficient use of limited urban street space. The parking space is adaptable to current situations


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and needs. (2) Sustainability: the bicycle rack addresses the issue of equity in urban street space allocation and delivers a vision of how street space might be shared differently. It stimulates debate, raises awareness for both sustainable mobility and use of street space. Thus, it might alter individual perceptions and potentially lead to a change of usage behaviour. (3) Climate neutrality: in the short term, the flexible bicycle rack leads to a more efficient use of the existing parking space. Long-term, the bicycle rack supports the smooth transition from cities shaped by fossil-fuelled mobility to more climate-neutral types of urban mobility. (4) Resilience: bicycle usage strengthens the resilience of cities when it comes to both climate change and global pandemics such as the current COVID-19 crisis. In order to promote bicycle usage, an adequate bicycle infrastructure needs to be available. Since built structures change only extremely slowly compared to the means of transport and usage requirements, the street space as a space for transformation is once again in the special focus. The subject of parking spaces, regardless of whether it is a car or bicycle parking space, will be an ongoing issue. The authors consider it valuable to be able to react flexible to future requirements with corresponding constructions. Awareness of cycling infrastructure is currently growing, so the corona situation should be understood as a reason for action, in which, together with the rapidly increasing proportion of cyclists, a lot can be achieved in various planning processes.

## 7 ACKNOWLEDGEMENTS

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