

## STATION TULLNERFERD: EVALUATION AND OPTIMISATION



Prof. Hermann Knoflacher

Carolina María Ciges Marín

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## 2. INTRODUCTION

Tullnerfeld is a region located in lower Austria, the biggest federal state in Austria, St Pölten is the principal city of the state after the independence of Vienna as a separate state.

The Tullnerfeld station belongs to the national railway company ÖBB and is on the way between the main cities of Vienna and Salzburg. It was opened on the 9<sup>th</sup> of December 2012 as part of the New Occidental Railways' plans to belong to the route *Magistrale for Europe*. The route *Magistrale for Europe* goes from Paris to Bratislava or Budapest, making stops at different cities along the way. The station has been so crucial for the growing economy of the region.

It is quite a modern train station because there is no personnel working there, you must buy your tickets at the machine, and all the train timetables are projected on an information system in real-time to keep the customers informed. It has eight rails but only five platforms. The reason is that some rails are reserved for the high-velocity trains that pass the station but do not stop.

The train station is in the municipality of Judenau-Baumgarten, near the villages of Michelhausen, Pixendorf, and Lagenrohr; located each of them to the train station at approximately 1,5 km. The trains from Vienna Franz-Josefs-Bahnhof's direction to St. Pölten Hbf pass every hour, during rush hours, even every 30 minutes. As the trains from Salzburg to the Vienna International Airport.

The train station is mainly used for people that live in the Tullnerfeld area and goes every day to work in Vienna. The station offered complementary services: some cafés, a building with offices, a pharmacy, and a playgroup.

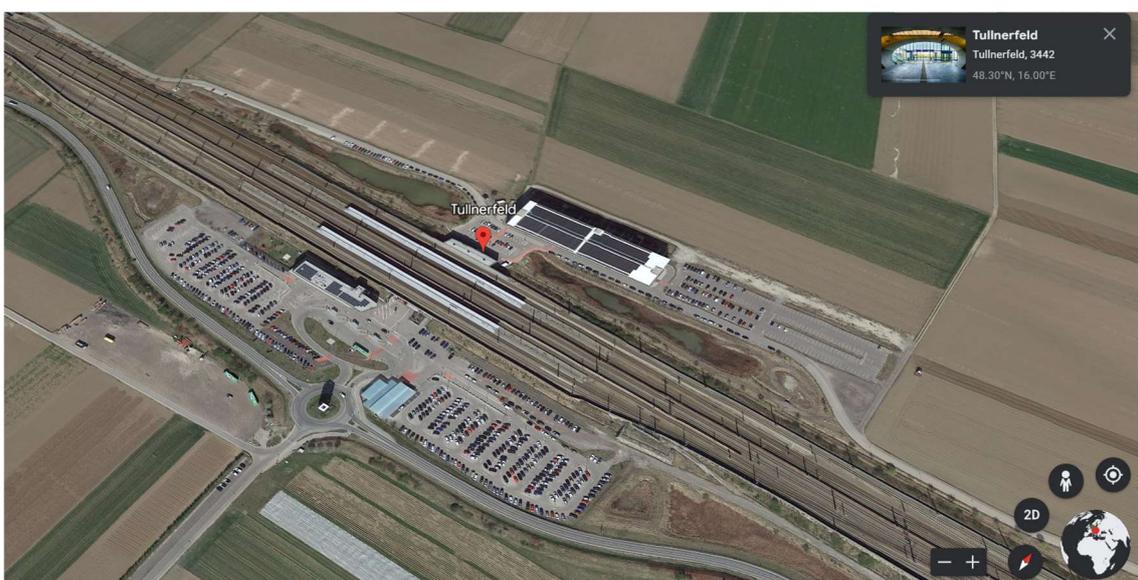


Figure 1: Areal view Tullnerfeld Station

### 3. OBJECTIVES

There are two main points in this bachelor thesis:

The first one is optimizing the location of bus stops, parking for bicycles and cars, numbers and land consumption, as well as the distance to the platforms and, on this basis, making suggestions on how to improve it concerning climate change.

The second point is the station's location to the surrounding villages - with population figures and distances and travel times by train to Vienna, St. Pölten, and Tulln.

### 4. THEORETICAL ASPECTS

#### 4.1 METHODOLOGY

##### **BUS STOPS**

There are three bus stops at the train station's south entrance, and from the bus stops to the platforms is just 3 minutes. The bus stops are located relatively close to the entrance, the issue is the frequency of the buses, some suggestions to improve this will be made forward.



*Figure 2: View of bus stops*



Figure 3: Areal view of bus stops



Figure 4: Total surface of bus stops

The land consumption of the bus stops, including the three stops and the extra space to rest for buses, is  $1365,31 \text{ m}^2$ , corresponding to a perimeter of  $187,31 \text{ m}$ . The distance from the bus stops to the platforms is  $73,52 \text{ m}$  in media.

### PARKING FOR BICYCLES

In the north area, there are parking spaces for bicycles with a metal bar system allocated at the floor level, near the entry 20 spaces without any protection.



Figure 5: Parking for bicycles at the north side

At the south part of the train station, the bicycle parking is very well prepared against rainy conditions and has enough space for bicycles. The parking for bicycles is together with the parking for motorbikes.



*Figure 6: Parking for bicycles south side*

For the bicycles, there are three ways of holding the bikes. The first one is with a new security system, there are 27 stations with this system; the second one is the traditional one with metal bars at the floor level, of this type there are 150 spaces. Finally, the third way of holding the bicycles is with a two floors system with a capacity for 96 bikes. In total, this parking station can store 273 bicycles.



Figure 7: Security system



Figure 8: One level system



Figure 9: Two level system

Next to the bicycles are a total of 30 spaces under the roof for the motorbikes.

For the motorbikes in the north part, there are four parking places without any weather protection.



Figure 10: Parking for motorbikes south side

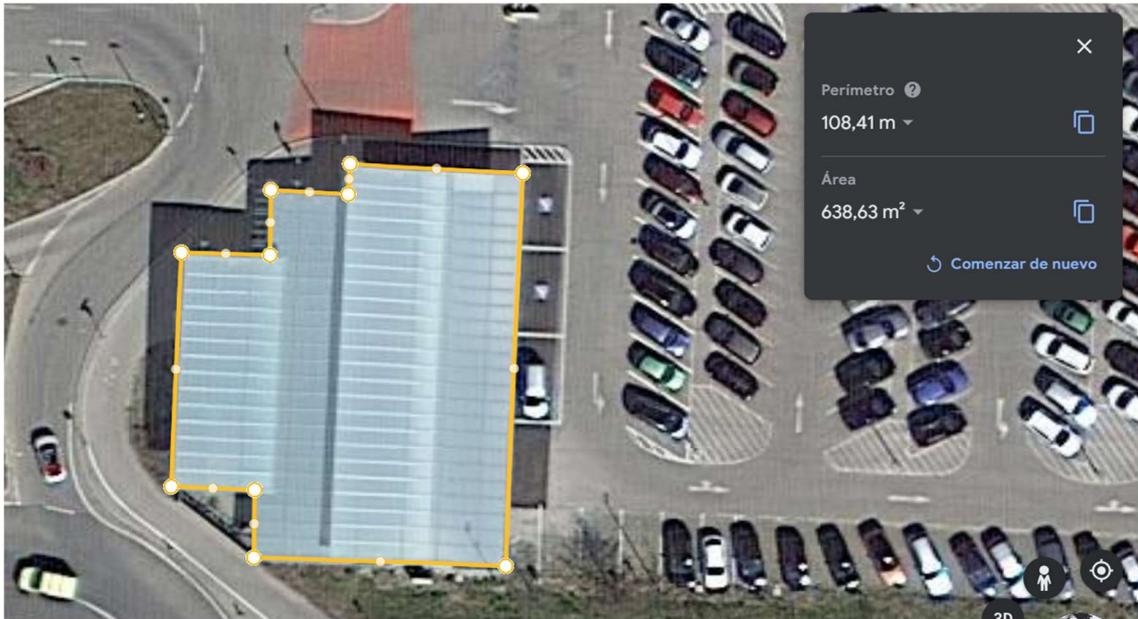


Figure 11: Total surface of the parking for bicycles and motorbikes at the south side of the train station

The area reserved for bicycles and motorbikes is 638,63 m<sup>2</sup>, corresponding to a perimeter of 108,41 m. The distance from the bikes to the platforms in media is 113,54 m.

From April until November, a service for renting bikes at the Tullnerfeld station with the company Nextbike is offered. These bikes are prepared for people who want to go to Tulln an der Donau, where the company's nearest bike station, or for tourists who come to Lower Austria to make some bike routes into nature.

## PARKING FOR CARS

The train station has two different areas for parking, the north and the south area. The south area is the principal entrance, well connected by roads to the main cities. Moreover, the northern part is connected to some small villages around; both sites relate to two tunnels that pass under the train rails.

## NORTH PART

At the north part of the station, there is a parking building without fee with five floors divided into two sublevels, each with a capacity for 712 cars; each level has approximately 65 parking places.

To go to the north side of the train station, you must go intentionally; this parking is prepared for the people that arrive on Monday morning and leaves the car here the whole week until they come back Friday afternoon after a working week in Vienna. The parking during the week is almost complete.



Figure 12: Reserved spaces for ÖBB workers

The north part has seven parking places reserved for the possible workers of the ÖBB located just in front of the door.



Figure 13: Areal view of the north parking

Moreover, the north part also has asphalt parking with a capacity for 306 cars, seven parking places reserved for the ÖBB, and ten places for disabled people in front of the entrance. That supposes a total surface of 8402,87 m<sup>2</sup>. The farthest car is 375 meters away, and the closer is just 45 meters, which are the places reserved for the ÖBB workers.

## SOUTH PART

The south part of the train station has asphalt parking, two surfaces located at both sites of the entrance. It has a capacity for 578 cars plus four places for disabled people. That corresponds with a surface of 15.306,02 m<sup>2</sup>. The furthest car is 300 meters away, and the closest is 63 meters.



Figure 14: Areal view of the south parking

There are 901 more or less parking places asphalted, with a land consumption of 23.711,88 m<sup>2</sup>. Adding the parking building with 712 sites with a land consumption of 3980,71 m<sup>2</sup>. As the big villages are far from the train station all the people around come with their own cars so almost all the parking is filled, even some cars are parking at the ground areas because they cannot find space.

The train station has almost 2000 car spaces with a land consumption of 27.692,59 m<sup>2</sup>, equivalent to three football fields.

The train station is located in the municipality of Judenau-Baumgarten; in the immediate area are the villages of Pixendorf, Baumgarten, Staasdorf, Langenrohr, Asparn, Gollarn and the city of Tulln an der Donau on the shores of the Donau. Here on the map, you can see the location:

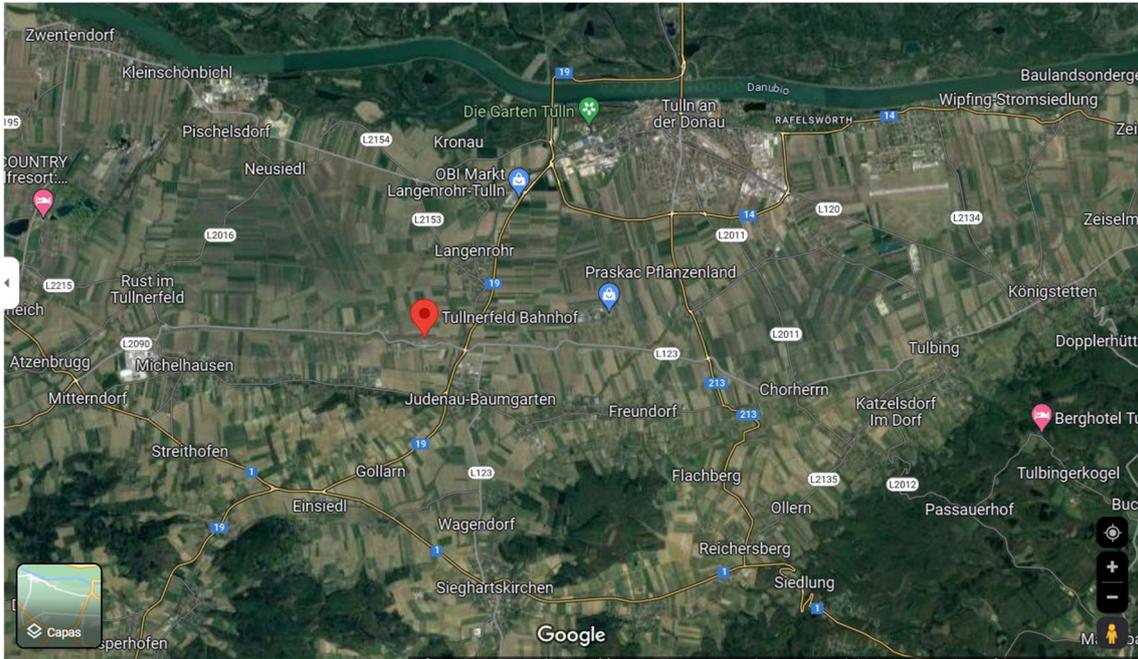
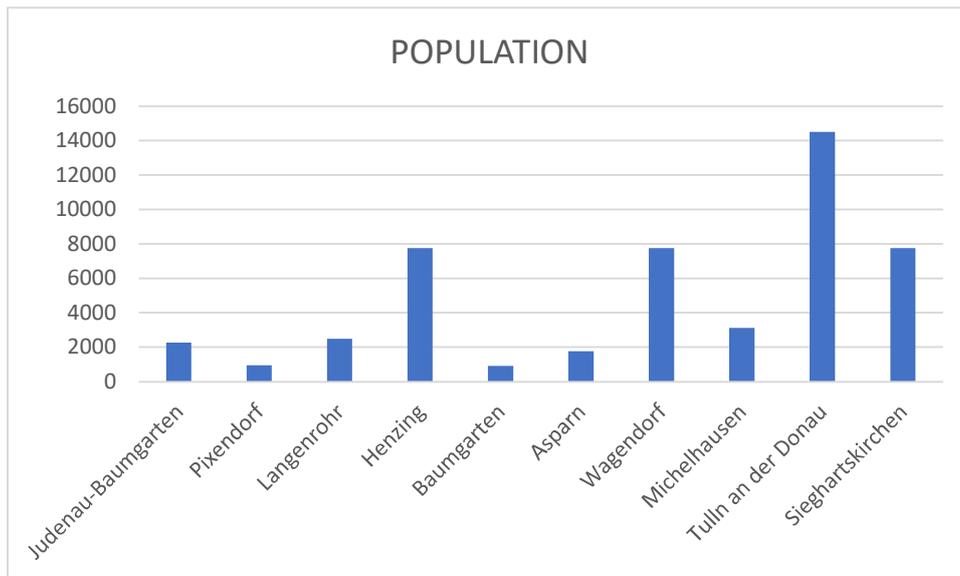


Figure 15: Areal view of the area around the station

This area has natural borders, at the north part the Donau and the south the Vienna Forest. In the following table, there is a list of the villages inside a radius of less than 10 km around the Train station.

CITIES	POPULATION	DISTANCE (km)	CAR (min)	BUS (min)
Judenau-Baumgarten	2262	1,9	4	4
Pixendorf	945	2,4	4	6
Langenrohr	2484	2,8	5	5
Henzing	7758	4,2	7	7
Baumgarten	912	4,4	6	9
Asparn	1767	4,5	8	No direct bus
Wagendorf	7758	4,8	8	8
Michelhausen	3113	6	7	12
Tulln an der Donau	14509	7,6	13	14
Sieghartskirchen	7758	8,5	9	9

The times with bus and car are approximately the same so the issue is the frequency of those buses.



This is the distribution of the nearest villages ordered in the x-axis from the closest (Judenau- Baumgarten) to the farthest (Sieghartkirchen). It can be noticed that the most significant town is Tulln an der Donau, and it is 7,6 km away from the station. The station's surroundings are filled with villages of less than 1000 habitants.

As the principal city of the district of Tulln, Tulln an der Donau has its train stations with direct connections to the north of Vienna, the train station Wien Nussdorf. The habitants of Tulln an der Donau, if they want to go to Vienna Main Train station, should change the train in Tullnerfeld; this is why many people go directly with their cars to the Tullnerfeld station daily. The train from Tullnerfeld to Vienna Main Train Station takes fifty minutes to arrive; however, it will take forty-six minutes by car.

The train S40 makes a stop at Michelhausen Bahnhof, a train station that is only four minutes by train away from Tullnerfeld, only this train because it is a regional one and makes many stops to connect all the little villages in the district.

## WIEN

TRAIN STATION	TIME	LINE	FREQUENCY
WIEN WASTBAHNHOF	23 min	CJX 5	each 60 min
WIEN HÜTTELDORF	13 min	CJX 5	each 60 min
WIEN HAUPTWAHNHOF	20 min	RJ	each 60 min
WIEN MEIDLIG	13 min	RJ	each 60 min
WIEN SPITTELAU BAHNHOF	53 min	S40	each 60 min
WIEN FLUGHAFEN	66 min	RJ	each 60 min

## ST PÖLTEN

TRAIN STATION	TIME	LINE	FREQUENCY
BAHNHOFPL.	14 min	CJX 5 / RJ	Each 30 min

## TULLN AN DER DONAU

TRAIN STATION	TIME	LINE	FREQUENCY
TULL AN DER DONAU	7 min	S40	Each 60 min
STATD BAHNHOF	4 min	S40 / S4	Each 30 min

## 4.2 ANALYSIS OF THE EXISTING SITUATION

Respecting the bus lines at the train station, you can get the lines:

BUS LINE	FREQUENCY	ROUTE
BUS 105	One per day	From Sant Pölten to Korneuburg
BUS 106	Operate during rush hours. In the morning, every 30 mins, and in the afternoon, every hour	From St Pölten to Klosterneuburg
BUS 140	Each hour	Direction Stockerau with few stops in Tulln an der Donau
BUS 409	Each 10 to 20 minutes	From Sieghartkirchen to Tulln an der Donau
BUS 410	Each hour	Judenau-Baumgarten , Freundorf and Tulln an der Donau
BUS 414	Operate during rush hours. Each hour	Langenrohr – Asparn – Zwentendorf-Dürnrohr
BUS 442	Two times per hour	From Leulengbach to Tulln an der Donau
BUS 443	Two times per hour	From Würmla to Tulln an der Donau
BUS 470	Each hour	Direction to St Pölten bus terminal

The buses cover a radius distance of 10 km around the station and some lines arrive at St. Pölten. These frequencies are reduced during the weekend.

To prepare all the asphalt areas for the cars, they use concrete, one of the most contaminated materials in construction, undergrounding the fields. Its production process contributes to greenhouse gas emissions. Each m<sup>2</sup> of asphalt could generate approximately 20 Kg of CO<sub>2</sub>. Producing the CO<sub>2</sub> during manufacturing and transportation, and construction at the location.

At the south part of the train station, there are four places for invalids, but this doesn't accomplish the normative OENORM B 1600, where the parking spaces for invalid people are contemplated. This space is far away from the entrance even the way to get to the entry is not well prepared with ramps; they should skip some steps before arriving at the entrance of the train station. These parking spaces are located 150 m from the entrance, a considerable distance.



Figure 16: Parking spaces reserved

Inside the train station, everything is well prepared for invalid people. There are no steps inside the station, and the platform access is through lifts.

At the train station's main entrance, the south entry, there is no protection against cars. So, it will be necessary to install some beacons to ensure the safety of the people inside the building.



Figure 17: Main entrance of the train station

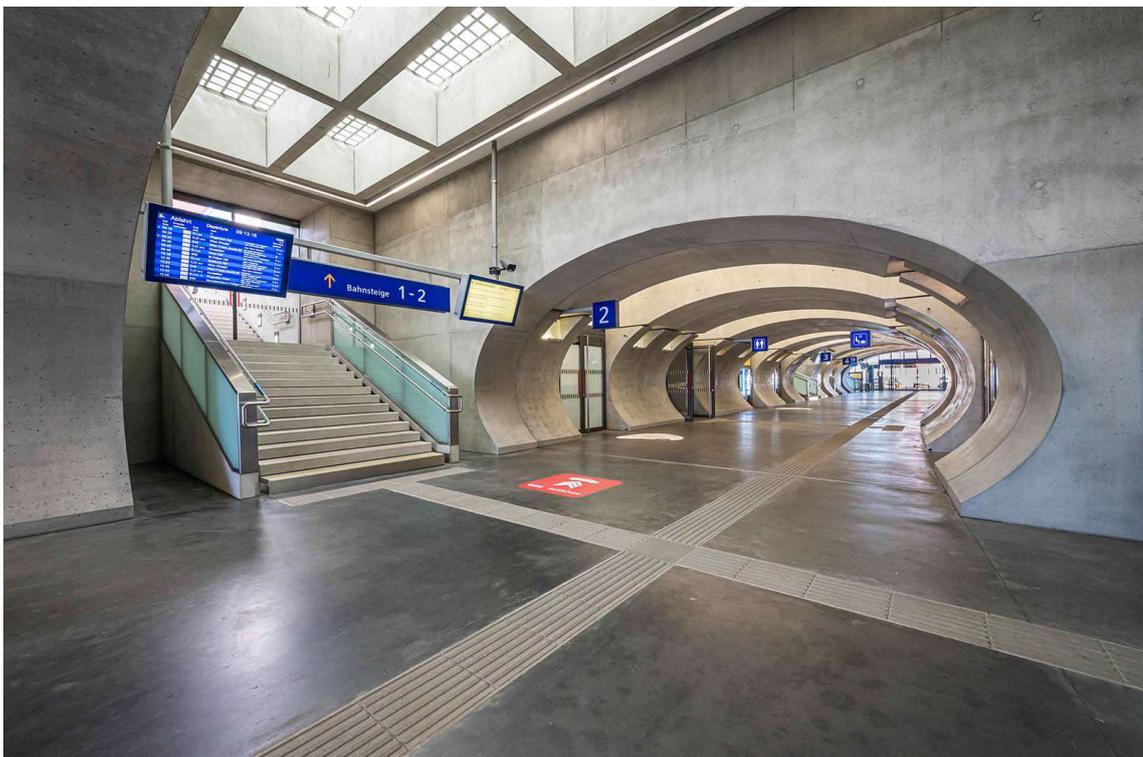


Figure 18: Interior of the train station

As seen in the picture, there is a central corridor where the platforms are distributed sequentially, making it easy to locate and access the different platforms.

### 4.3 QUANTITATIVE ANALYSIS

The following table will analyze the train station quantitatively, evaluating it with a 1 for the best and a 5 for the worst.

When walking or riding, people use much energy; instead of that with a car or public transport, they don't use that energy. Cars and public transportation don't have any limiting distances because they can reach huge distances.

	Radius	Pot	m <sup>2</sup>	NUMBER VEHICLES	m <sup>2</sup> /NV	N	Vol	REAL %	IDEAL %
PEDESTRIANS	-	1	-	-	5	5	10	5	50
CYCLIST AND MOTORBIKES	<2 km <10 km	2	638,63	307	2	1	9	10	25
PUBLIC TRANSPORT	No limit	4	1.365,31	50	3	4	9	15	25
CARS	No limit	5	27.692,59	1613	3	4	0	70	0
<b>TOTAL</b>			29696,53	1925				100	100

## 4.4 EVALUATION

As we can see, the land consumption for cars is too big comparing the space used for bikes and public transport.

At the location of the train station, the access to the pedestrians is not guaranteed.

The ideal train station is one where mainly the pedestrians can come easily, so at least pedestrians will represent 50% of the station users. In the perfect case, we will complete the 100% with bikes and public transport. So there will be no presence of cars.

In this train station, the situation is just the other way, with no percentage of pedestrians or at most 5%, as the villages are located far away, and there needs to be better communication with paths for pedestrians. The percentage of people using bikes and motorbikes is 10%, a meager rate compared to the ideal case. The percentage of people that use public transport will be 15%, a little bit more than those that come by bike but still far from the ideal case.

## 4.5 CONCLUSIONS

This train station is mainly used by people in the Tulln region working in Vienna. Some go every day; others go on Monday and stay in Vienna until Friday. As we can see at the distribution time of google maps, the inflow of people on Sundays is less than the working days. Also, during the working days, the maximum influx corresponds with the entry and exit time from work.

RUSH HOUR SUNDAY



RUSH HOUR MONDAY



## RUSH HOUR FRIDAY



The train station has plenty of services, including a kindergarten, where the workers who are also parents can leave their children until they return from work.

### 4.6 RECOMMENDATIONS FOR IMPROVEMENT

The train station is located far away from the main villages so to reduce the number of cars is so important to increase the bus frequency. When they return to work, the people want to return home as soon as possible; if the buses offer a good service at many hours, the public transport will cover that requirement. The environment will be less contaminated if the number of cars is reduced.

The bicycle's location is far away from the entrance, so the bicycle parking should be near the door, which now exits parking for cars. The parking for bicycles is well protected against climate conditions. To ensure that the bicyclist arrives inside the building without getting wet, it should be necessary to install a shed. In the north part, it will be crucial to rearrange the parking for bicycles next to the north entry and cover it with protection against the weather conditions.

The stop for the taxis is closer than the stop for the buses, as the car used for the taxi service is more contaminated than the bus; following the same criteria to rearrange the space, the bus parking should be closer than the taxi stop.

Here at the picture you can see both changes:



*Figure 19: Proposal of distribution of the south side*

To demolish the concrete that is built will be highly damaging to the environment, so we can reuse that space by changing the parking for cars to charges for electric vehicles that are less contaminating. Or with the same area, it can be fitted more bicycles or motorbikes.

Cars are the most contaminated way of transport between cars, bicycles, and buses, so we are not interested in improving the installation of cars.

The roof of the parking building is provided with solar panels; a great way of reducing contamination should be using the electricity we obtain from the sun to charge the electric cars. It could be possible to increase the number of solar panels by installing them on the top of the bicycle parking. Promoting the use of electric vehicles will reduce the impact on the environment.

At the train station's main entrance, the south entry, there is no protection against cars. So, it will be necessary to install some beacons to ensure the safety of the people inside the building.

## 5. REFERENCES

Asocem <http://www.asocem.org.pe/productos-a/el-cemento-y-el-medio-ambiente>

Bahnhof Tullnerfeld - ÖBB-Bahnhöfe (oebb.at)

Cepsa [https://www.cepsa.es/es/utilidades/catalogo/asfaltos/carretera/liqantes-aplicaciones-sostenibles?utm\\_source=google-sem&utm\\_medium=direct\\_buying&utm\\_content=google-sem\\_cepsa-com\\_tra\\_na-segmentation\\_asfaltos\\_26042023\\_31122023\\_ros-dtxt\\_1x1\\_pcc\\_cpc&utm\\_term=yndia&utm\\_campaign=cepsa-b2b-asfaltos-br\\_cepsa-com\\_asfaltos\\_11042023\\_31122023&qclid=Cj0KCQjwslejBhDOARIsANYqkD0O1qdt5b1ckqLBp0VM4mZQa-MpN-NdWyZopn\\_JUNZFhC\\_XkdkRZBoaAqB0EALw\\_wcB&qclsrc=aw.ds](https://www.cepsa.es/es/utilidades/catalogo/asfaltos/carretera/liqantes-aplicaciones-sostenibles?utm_source=google-sem&utm_medium=direct_buying&utm_content=google-sem_cepsa-com_tra_na-segmentation_asfaltos_26042023_31122023_ros-dtxt_1x1_pcc_cpc&utm_term=yndia&utm_campaign=cepsa-b2b-asfaltos-br_cepsa-com_asfaltos_11042023_31122023&qclid=Cj0KCQjwslejBhDOARIsANYqkD0O1qdt5b1ckqLBp0VM4mZQa-MpN-NdWyZopn_JUNZFhC_XkdkRZBoaAqB0EALw_wcB&qclsrc=aw.ds)

El confidencial [https://www.elconfidencial.com/tecnologia/ciencia/2020-09-07/asfalto-ciudades-gran-fuente-contaminacion\\_2738492/](https://www.elconfidencial.com/tecnologia/ciencia/2020-09-07/asfalto-ciudades-gran-fuente-contaminacion_2738492/)

El diario [https://www.eldiario.es/internacional/theguardian/cemento-material-destructivo-tierra\\_1\\_1675968.html](https://www.eldiario.es/internacional/theguardian/cemento-material-destructivo-tierra_1_1675968.html)

Google Earth

[https://earth.google.com/web/search/tullnerfeld/@48.2954497,15.9966222,184.62501102a,674.70171317d,35y,0h,45t,0r/data=CnYaTBJGciUweDQ3NmQ3NmVknWYxOGZiYWQ6MHhhY2JiM2M4MGI3ODM3M2FjGUyTCEPTJUHAiQuk1dpF\\_i9AKgt0dWxsbmVyZmVsZBgCIAEiJgokCaS61falvTNAEaG61falvTPAGak1G5oJP0IAIak1G5oJP0nAKAI](https://earth.google.com/web/search/tullnerfeld/@48.2954497,15.9966222,184.62501102a,674.70171317d,35y,0h,45t,0r/data=CnYaTBJGciUweDQ3NmQ3NmVknWYxOGZiYWQ6MHhhY2JiM2M4MGI3ODM3M2FjGUyTCEPTJUHAiQuk1dpF_i9AKgt0dWxsbmVyZmVsZBgCIAEiJgokCaS61falvTNAEaG61falvTPAGak1G5oJP0IAIak1G5oJP0nAKAI)

Google Maps

Growbuildings <https://growingbuildings.com/construccion-y-emisiones-co2-a-la-atmosfera/#:~:text=Cada%20tonelada%20de%20cemento%20en,emisiones%20de%20di%C3%B3xido%20de%20carbono.>

Isostatika <https://isostatika.com/blog/emisiones-co2-obra-nueva-2021/>

Marca <https://www.marca.com/futbol/reglas/2021/01/20/5e762a8aca4741f8278b4582.html>

Niederosterreich [Bahnhof Tullnerfeld \(niederosterreich.at\)](https://www.niederosterreich.at/bahnhof-tullnerfeld)

Office Station [OFFICE-STATION | Büroflächen am Bahnhof Tullnerfeld](https://www.office-station.com/buero-flaechen-am-bahnhof-tullnerfeld)

Orte in Osterreich <https://www.orte-in-oesterreich.de/66596-ort-staasdorf.html>

Wikipedia: Michelhausen <https://de.wikipedia.org/wiki/Michelhausen>

Wikipedia: Tulbing <https://es.wikipedia.org/wiki/Tulbing>

Wikipedia: Tullnerfeld <https://de.wikipedia.org/wiki/Tullnerfeld>

Wikipedia: Westbahn

[https://de.wikipedia.org/wiki/Westbahn\\_\(%C3%96sterreich\)#Neue Westbahn .28Strecke 30.29](https://de.wikipedia.org/wiki/Westbahn_(%C3%96sterreich)#Neue_Westbahn_.28Strecke_30.29)

Wikipedia: Wien <https://de.wikipedia.org/wiki/Wien>

Zugradar.info <https://zugradar.info/>

ÖNORM B 1600 sind die "Planungsgrundlagen für das Barrierefreie Bauen" definiert (z.B. Gehsteige, Rampen, Eingangsbereiche und Türen).

[https://www.oesterreich.gv.at/themen/bauen\\_wohnen\\_und\\_umwelt/bauen/1/Seite.1270100.html#B1600](https://www.oesterreich.gv.at/themen/bauen_wohnen_und_umwelt/bauen/1/Seite.1270100.html#B1600)