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Research into possible implementation of train-trams in the Ostrava region

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Zásady pro vypracování:

Na zadaném území proveďte analýzu možnosti zavedení systému vlakotramvají jako řešení regionální dopravní obsluhy. Zvažte nevyužívané železniční trati, vlečky i případné vybudování nových spojení. Diplomovou práci zpracujte v jazyce anglickém.
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1a - analýza místních poměrů
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1c - popis navrhovaného technického řešení
1d - popis možných tras vlakotramvaje v řešeném regionu
1e - zhodnocení
2. Přehledná situace jednotlivých variant 1:10 000
3. Mapa plošné dopravní obsluhy (izochrony) 1:10 000
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ČSN 73 6360 - Konstrukční a geometrické uspořádání koleje železničních drah a její prostorová poloha
ČSN 73 4959 - Nástupiště a nástupištní přístřešky na drahách celostátních, regionálních a vlečkách
Kubát, Trešl - Stavby kolejové dopravy, ČVUT, 2008. 190 s. ISBN 978-80-01-03983-0
Kubát, Pejša, Jacura, Trešl - Městská a příměstská kolejová doprava, Wolters Kluwer ČR, 2010, ISBN 978-80-7357-539-7

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ABSTRACT

This thesis deals with a design of a possible implementation of train-trams in the Ostrava region. An essential part of this thesis is a set of drawings, where particular horizontal alignments of designed lines are presented. Drawings of cross sections and a scheme of a station are also included. The written part of this thesis contains a description of inclusion of the proposed design to broader relations. Furthermore, train-trams specifications are presented, and the proposed design is described in depth.

KEYWORDS

Train-tram, tram-train, train, tram, railway, infrastructure, network, interoperability

TITUL

Prověření možností vlakotramvají na Ostravsku

ANOTACE

Tato práce se zabývá návrhem možného zavedení vlakotramvají v Ostravském regionu. Důležitou částí této práce je sada výkresů, která obsahuje přehledné situace navržených vlakotramvajových linek. Ve výkresové části jsou rovněž obsaženy výkresy řezů a schématu jedné stanice. Textová část této práce obsahuje popis začlenění navrhovaných linek do širšího kontextu. Dále jsou v této práci představeny specifikace vlakotramvají a detailně popsány navržené trasy vlakotramvají.

V úvodní části je rozveden popis systému úzkorozchodných drah, který byl na Ostravsku v provozu mezi léty 1902 a 1973, jehož síť tvořila základ dopravní obslužnosti většiny sídel v oblasti a na nějž by mohl navrhovaný systém vlakotramvají navázat. V další části je proveden stručný popis osídlení regionu s důrazem na jeho strukturu a význam tohoto rozmístění sídel vzhledem k potenciálnímu provozu lehké kolejové dopravy v regionu. Následně je také připomenut nevalný stav české legislativy a norem pro oblast vlakotramvají. Čtvrtá kapitola je věnována shrnutí specifikací, kterými se vlakotramvaje liší od konvenčních vlaků a jak je možno tyto specifikace využít (v případě pozitivních odchylek) či naopak eliminovat (v případě odchylek negativních). Následná kapitola detailně popisuje jednotlivé navržené trasy vlakotramvají. Závěrem nechybí ani shrnutí celé řešené problematiky a řada příloh.

KLÍČOVÁ SLOVA

Vlakotramvaj, tramvajovlak, vlak, tramvaj, infrastruktura, síť, interoperabilita

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LIST OF ABBREVIATIONS

MSLAG ....

Mährisch-Schlesische Lokalbahn Aktien-Gesellschaft (Moravian-Silesian Local Railways Joint-Stock Company)

MDOK ....Místní dráha Ostrava – Karviná (Ostrava – Karviná Local Railway)

ICE ....InterCityExpress

KFNB..................... Kaiser Ferdinands-Nordbahn (The Emperor Ferdinand Northern Railway)

DC.. Direct current

PROLOGUE

This diploma thesis aims to contribute to the general discussion of implementation of train-tram systems in the Czech Republic in a technical point of view. The first ideas of implementation of such a system were incorporated into the General Transport Plan of the city of Ostrava in 1997. Since that time, plenty of comments, assessments and studies have been released. Even though the financial situation of the Czech Republic is not that positive as it was before the Great Recession, the responsible authorities shall not leave the discussions of technical improvements. Such innovations proved to be very helpful once a country is recovering from a crisis. This thesis presents a possible implementation of train-tram system in the Ostrava region with an accent on cost-effectiveness of the solution, as responsible authorities could prone to selection of the cheapest possible option.

This thesis uses an expression “train-tram”, although an expression “tram-train” appears to be more frequent in world literature. However, the difference of both terms is derived from vehicle types operated in such a network. Where tram-like vehicles are modified to operate on railway lines, too, an expression “tram-train” is used and vice versa. Since this thesis deals only with the infrastructure part of the study, an expression “train-tram” is used as this is a literally closer translation of a common Czech expression “vlakotramvaj” that is used for such types of vehicles.

In the first chapter, historical relations are presented. An extensive part is dedicated to a narrow gauge network that was more than 70 years in operation.

In the second chapter, the demography of the discussed region is analyzed.

The third chapter analyses the status of implementation of legislation and standards regarding the discussed topic.

In the fourth chapter, specifications of train-tram vehicles, especially in comparison to conventional railway vehicles, are presented.

In the fifth chapter, a detailed description of the proposed project is presented.

Finally, extensive appendixes conclude the thesis.

1 HISTORICAL BACKGROUND

Within area of the current Czech Republic, the Ostrava region is demographically unique. Cities and villages of moderate population are spread very evenly over whole black coal basin, almost reaching each other, and creating an urbanized network that appears as one large town of a very low density of population in average.

Development that led to this situation started in 19th century. Local entrepreneurs discovered that there is much more black coal in the depth than just under the surface. As a result, Anselm coal mine (originally Ferdinand coal mine) was opened in 1830. Other coal mines followed quickly. As soon as around 1865, mining reached one million tons of black coal. [1]

Demand for black coal was huge. Together with large quantities of black coal underground and arrival of many people from whole Austrian empire and abroad looking for a job, population was rising quickly. New workers' settlements were built between existing villages and soon connected to them.

In the meantime, important Austrian entrepreneurs, including Salomon Mayer Rotschild, founded the Emperor Ferdinand Northern Railway. A company which built a railway of the same name (originally "Kaiser Ferdinands-Nordbahn, KFNB"). This railway was designed to connect Vienna and Bochnia where large salt mines had been situated. This railway reached Ostrava region by opening of the section to Bohumín (in that time called Oderberg) on 1st May 1847. [2] Rising significance of black coal prevailed over the former interest in carrying salt from Galicia. Coal transport became the major part of workload of the KFNB soon. A few years later, other railways started their operation and the region was decently equipped with transport infrastructure. Two of the most important railways opened after the KFNB line Vienna - Bohumín were Košice – Bohumín Railway and Mining Railway, the latter one built by the KFNB. [2]

Figure 1 - A historical view of Bohumín railway station [3]

In the 19th century, however, railway was not adopted by citizens as it is today. People were afraid of new machines and did not want railways to be built close to their houses. This happened in Bohumín, too. The KFNB were forced to place the new railway station further from the town on the cadastre of Šunychl village. [4] A new settlement was established around the placement of the railway station. The place was called Nový Bohumín (New Bohumín, often referred to as Bohumín nádraží, in that time Oderberg Bahnhof). A few decades after that, Bohumín city government could see the town had been struggling in development, whereas New Bohumín had rapidly developed into prospering centre of the area. This led the city to decide of construction of a horse-drawn narrow gauge (760 mm) tram line from Bohumín square to the railway station in New Bohumín. [4]

Figure 2 - Opening of operation of the horse-drawn line on the Bohumín city square on 22th December 1902 [4]

The operation of Municipal Railway in Bohumín started in 1902 and as soon as one year later, steam engine replaced horses on the track. Electrical carriages were placed into operation in 1916. [4]

City of Polská Ostrava had a similar intention as Bohumín. Situated around 3 km from the closest station of KFNB, Hrušov, they realized, a railway connection would help the city to develop. The original intention to build a normal gauge electrical railway was modified. Due to the unwillingness of the KFNB for a competition, the 760 mm narrow gauge had been chosen. It was the same gauge like in Bohumín. Financial abilities of Polská Ostrava city then modified the project of electrical engine railway into a steam engine one. [4]

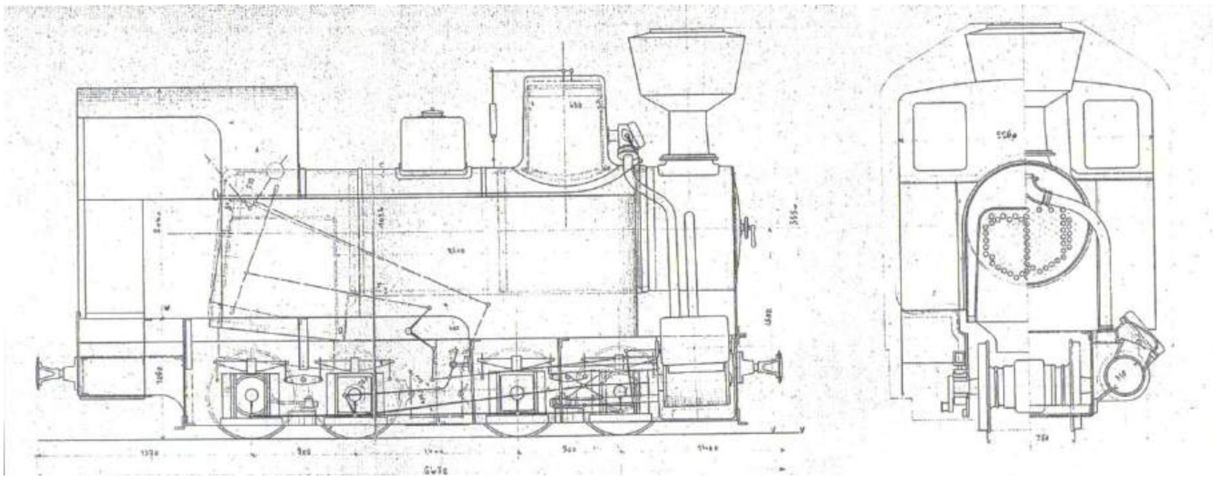

Figure 3 - Steam locomotive MSLAG I "Hanzel" (Krauss Linz 5047/1903) [4]

Railway Hrušov – Polská Ostrava started its operation in 1903. Subsequently, it was electrified in 1911. [4]

These railways put a basis for a whole network of narrow gauge railways in the region. With more and more coal mines opened and many new miners' villages established, one of the most important cities of the region, city of Moravská Ostrava, was determined to ensure a construction of local (from here results the name of tram in local dialect "lokalka") railway line from Moravská Ostrava to Karviná, a city with population of 20 000. However, the approximately 20 km long 760 mm narrow gauge railway track served not just as a connection of two important cities. Its importance lied in connecting a substantial amount of coal mines on the way as well as many villages. Its route, despite being ca 20 km long, was situated with almost all its length in an urbanized area. The operation started in 1909. Electrical engine had been used from the very beginning of the operation. Connecting the miners' neighborhoods and the coal mines, the Local Railway Ostrava – Karviná became soon an essential part of the transport system in the region. [4]

Figure 4 - Terminal station of MDOK with engine car No. 2 on Antonínovo square in Moravská Ostrava before 1918 [4]

The assets of the Local Railway Ostrava - Karviná had been very inspiring for the villages that were not connected to the railway network. The mayors exerted pressure on the Duchy of Upper and Lower Silesia representatives to solve the issue of their mutual connection. It resulted in establishing of Silesian Provincial Railways. This company built around 40 km of new railway tracks. The new lines enabled to close the circle of narrow gauge tracks in the region. [4]

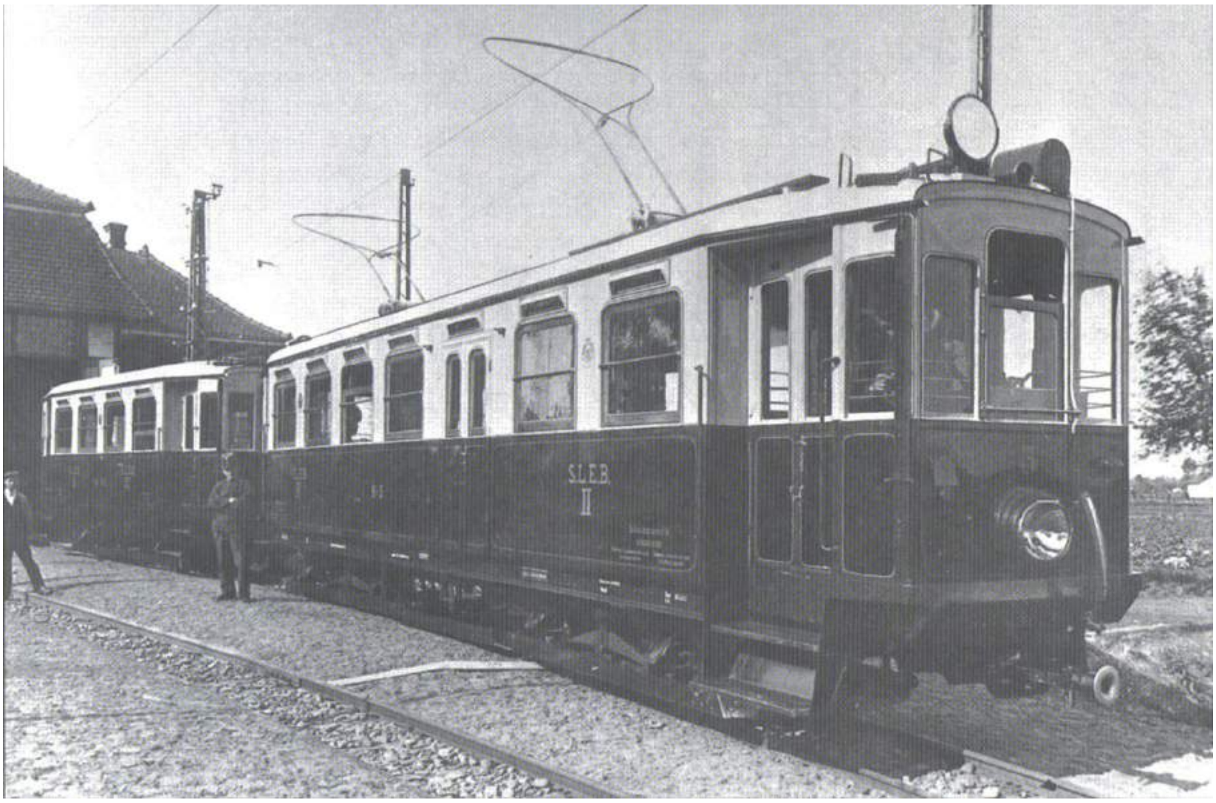

Figure 5 - Motor car No. 5 with towcar No. 103 in front of depot in Fryštát at the technical-police test of the railway line Karviná – Fryštát on 27th September 1912 [4]

During the time of its largest development, the total length of the narrow gauge lines in the Ostrava region was around 78 km with additional tens of kilometers of normal gauge lines. Systematic dispose of this transport system started in the middle 1950s when the regional government heavily supported construction of new roads and bus transport. [4]

From the look into history, it is clear that the region is bound to the railway transport; it has a large history in the region and in many cases, relics in the form of embankments or earthworks remained.

2 LOCAL CONDITIONS ANALYSIS

The city of Ostrava is the third largest city in the Czech Republic. According to the data released by the Czech Statistical Office, there were 297 421 inhabitants living in the city of Ostrava by 1st January 2013. [5] The population of other important cities in the region is presented in the following table. Cities are listed in descending order by population.

Table 1 - Major cities in Ostrava region by population [5]

City	Population (1st January 2013)
Havířov	77371
Opava	58054
Karviná	57842
Frýdek-Místek	57523
Třinec	36401
Orlová	30722
Český Těšín	25106
Bohumín	21726

There are other cities and municipalities that are located in the designed alignments of the tram-train lines. Those are listed in the following table. For a better notion, cities from the previous table that are supposed to be connected by the designed train-tram lines are included in the following table, too. Cities are listed in descending order by population.

Table 2 - List of cities connected by proposed tram-train lines by population [5]

City	**Population (1st January 2013)**
Havířov	77371
Karviná	57842
Třinec	36401
Orlová	30722
Český Těšín	25106
Rychvald	7216
Petřvald	7094
Šenov	6139
Stonava	1854
Ropice	1530
Chotěbuz	1194

The population in all cities connected by the proposed lines reaches 549 890, with 297 421 in the city of Ostrava and the rest, 252 469, in other cities in the region.

There are very strong transport relations between cities in the region. Apart from individual car transport, bus connections, as the only transport system in the city of Orlová, are very frequent. In the rush hours, the interval of bus departures between Ostrava and Orlová is as high as 15 minutes. [6]

3 LEGISLATION AND STANDARDS

By now, there is no special legislation or standards unifying the design and construction of train-tram lines in the Czech Republic.

Standards for geometrical characteristics of railway tracks (ČSN 6360-1) do exist but do not mention any specification regarding the train-tram systems. As the closest standards to the problem of train-tram tracks design, these standards were chosen like a base for all necessary calculations. However, it is highly required to create such a standard to enable possible development of train-tram systems in the Czech Republic. Designing of train-tram systems without any basic standards and legislation appears to be highly ineffective and diversity-susceptible.

For the purpose of filling this gap in legislation, a good example can be the existing train-tram systems in the United States of America, the United Kingdom and especially in the Karlsruhe area in Germany.

4 TECHNICAL SOLUTION SPECIFICATIONS

Train-tram systems and their networks are considerably different than a normal railway. Even though the needed legislation and standards are not created yet, as mentioned before, the differences must be and were taken into account when designing a train-tram system that is presented.

4.1 Specification of train-trams

The most apparent specification of train-trams is the avoidance of changes of transport means by passengers. Whereas passengers travelling by train from one city to another one have to change to tram to reach their destination in the particular city, they can have a direct ride in both intercity and intra-city sections when using a train-tram. Nevertheless, there are more technical specifications in train-tram systems. [6]

4.1.1 Passive safety on conventional railway tracks

Usual trams are designed for possible collisions with road vehicles. Therefore, their construction can be much lighter than a construction of a conventional railway vehicle. Train-trams, on the other hand, need to be designed for possible collisions with conventional railway vehicles. This condition causes a heavier construction of train-trams in comparison to usual trams.

4.1.2 Axle mass on tram tracks

Due to the heavier construction of train-trams in comparison to normal trams, as described above, and due to the common necessity to place a transformer of railway power supply system into train-trams, the axle mass of train-trams reaches higher values than the axle mass of regular trams.

4.1.3 Wheelchair accessibility of the vehicles

In the Czech Republic, railway platform edges are designed 550 mm above a rail top level. [7] In contrary, tram platform edges are typically 200 mm above a rail top level.

Using vehicles with a floor 550 mm above a rail top level is possible but not suitable since the wheelchair accessibility is not ensured at the tram stops. Using vehicles with a floor 200 mm above a rail top level is inapplicable without structural modifications of the platforms because getting off a train on a platform which is higher than the train's floor is limited by the door's lintel.

4.1.4 Interior arrangement

A potential trouble of a train-tram design is interior arrangement. Regular trams use mainly a very plain design and a lot of standing places, whereas suburban trains offer more seats and a bit higher comfort as it is expected the passengers will spend more time in the vehicles. A train-tram has to offer a compromise of these two approaches.

4.1.5 Wheel-rail interface

Because of a different construction of railway superstructure in railway and tram tracks, it is often not suitable to use tram or railway wheels in a train-tram. Even if it was possible, using of unsuitable wheels may cause fast wearing of rails as well as wheels.

However, there are basically two options that solve this problem. First is a use of rails that are suitable for both types of vehicles, e.g. rail type NP4. [6] Second option is to develop wheels able to ride on both, railway and tram rails. Many railway vehicles manufacturers have made a lot of improvements in this area of research.

4.1.6 Different traction systems

There are four different traction systems in the Czech Republic – 3000 V, DC; 25 kV, 50 Hz; 1500 V, DC and 15 kV, 16.7 Hz. Typical tram traction systems are 600 V, DC and 750 V, DC. Shall a train-tram vehicle operate under both types of traction system; it has to be designed for this purpose, unlike typical trams.

A very special place is a contact place of railway and tram traction systems. Such a place shall be outside any station and in straight section of a track. Vehicles ride through this place only by their inertia, without electricity offtake, and need to have enough velocity to get over this section in both directions.

4.1.7 Structural clearances

Train-tram systems have to respect both limitations of structural clearances, railway track ones and tram track ones. This can sometimes be a problem at platforms.

4.1.8 Signaling and communication equipment

Functioning and reliable signaling and communication equipment is an important part of every transport system. Among train-trams, there is a necessity of communicating with both, railway and tram controllers.

4.1.9 Financial costs of maintenance

Train-tram vehicles have to undergo the same maintenance like railway vehicles.

4.2 Examples from abroad

Railway transport as one of the most common suburban transport types is very widely used in many large cities, especially in the Western Europe. However, train-tram systems are not that much widened yet.

4.2.1 Light rail systems

Light rail systems are very popular in the United Kingdom. The first modern light rail system and one of the largest in the United Kingdom is the Tyne and Wear Metro, locally known as the Metro.

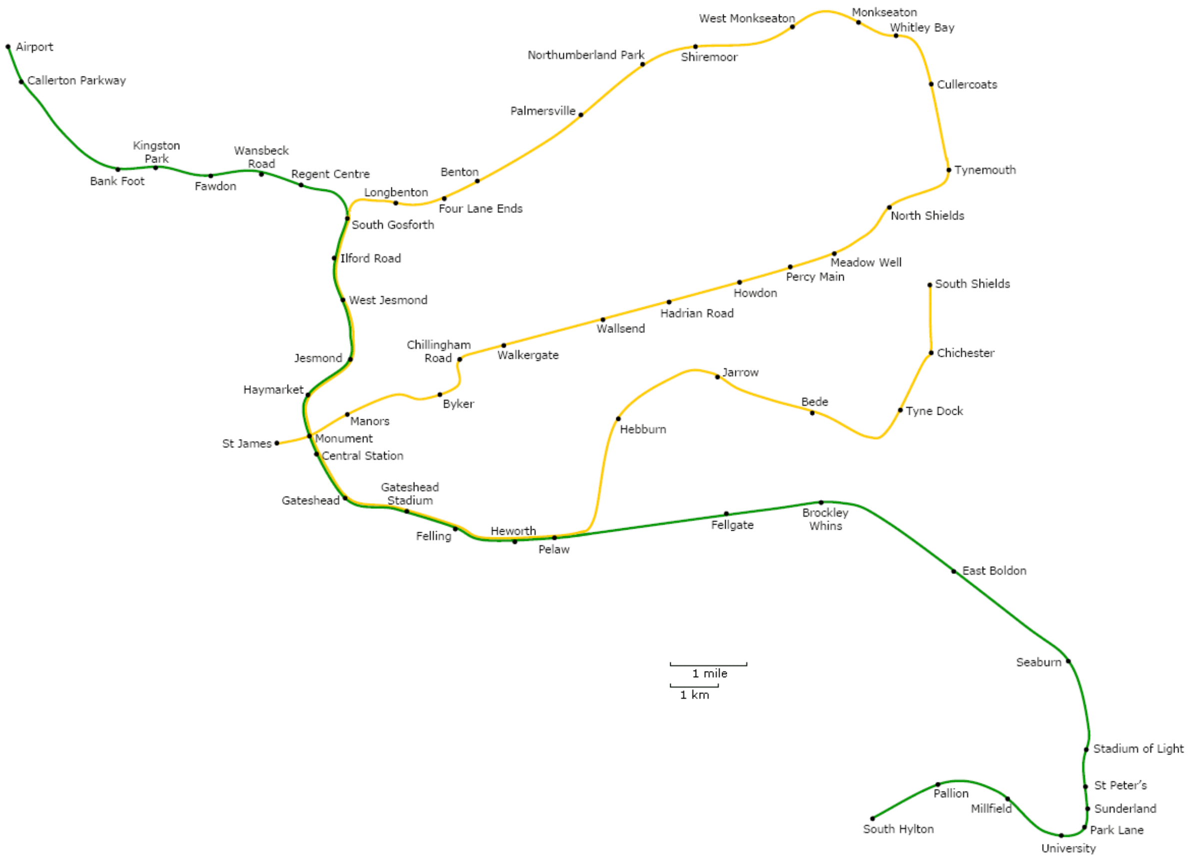

Figure 6 - Geographically accurate map of the Tyne and Wear Metro [8]

The Tyne and Wear Metro was opened in 1980 and now includes more than 70 kilometers of tracks. In 2011/12, daily ridership reached more than 100 000 passengers. [9]

In the United States of America, the term “Light railway” has a bit different meaning. Due to the technical parameters of normal rail vehicles, e.g. longitudinal force in a coupler axis up to

4000 kN, every train that meets criteria of interoperability for conventional European tracks belongs to the category of Light rail transit. [6] As an example, very similar to train-tram systems is the South Shore Line at the borders of Illinois and Indiana. This railway crosses Michigan City in its street system as pictured below.

Figure 7 - A South Shore Line train riding in the streets of Michigan City [10]

4.2.2 Train-tram systems

The most comprehensive train-tram system in the world operates in the region of a German city Karlsruhe. [6] Local transit authority operates a system of 411 kilometers of train-tram lines. The Karlsruhe train-trams now serve as a model of this kind of transit.

The idea of vehicles that use both, conventional tracks and tram tracks, and reduce the necessity of changes done by passengers was developed and realized step by step in Karlsruhe in 1980s and 1990s.

Figure 8 - An ICE unit and a tram-train vehicle side by side in one station near Karlsruhe [11]

4.3 Advantages of the train-tram system in the Ostrava region

By now, a train-tram system is not used in the Czech Republic, yet. However, there were more options discussed, where train-tram system can be launched.

Naturally, one of the areas considered for an application of a train-tram system was Prague. Despite proposing several connections of railway and tram network, an article written by Mr. Pavel Houda showed that there are many technical problems that limit a possible implementation of train-trams in Prague. [12]

Another area of possible implementation of train-trams in the Czech Republic is the Liberec – Jablonec nad Nisou region. A large tram network of gauge of 1000 mm was extensively dismantled. The only remaining section of this network, the tram line Jablonec nad Nisou – Liberec, copies the alignment of the railway track Liberec – Jablonec nad Nisou – Tanvald – Harrachov – Skłarska Poręba. The existence of two parallel tracks led to the idea of creating a train-tram system in the region. However, a study indicated that financial requirements of construction of this system would be too high to realize the system earlier than in horizon of 10, or more probably, 20 years. [6]

The most suitable region in the Czech Republic where a train-tram system could be created is the Ostrava region. It is a rather flat area with an extensive railway infrastructure and high population density.

4.3.1 Rail head profile

The tram network of Ostrava is the only one in the Czech Republic that uses rail head profile similar to the one used in conventional railway network. [6]

4.3.2 Tram wheel flange

In compliance to 4.3.1, wheel flanges of trams in Ostrava are similar to wheel flanges used in conventional railway network. [6]

Figure 9 - A wheel of a tram from Ostrava with a part of broken axle [13]

4.3.3 Existing infrastructure

The existing railway infrastructure in the region is very dense. It can be divided into several types of tracks.

The basic railway network is the conventional one, which is administrated by Railway Infrastructure Administration.

Figure 10 - Network of conventional railways administered by Railway Infrastructure Administration (colors represent track speeds) [14]

Figure 11 - Track speeds legend to the preceding figure [13]

Additional railway network consists of tram tracks administered by Ostrava Transport, joint-stock co.

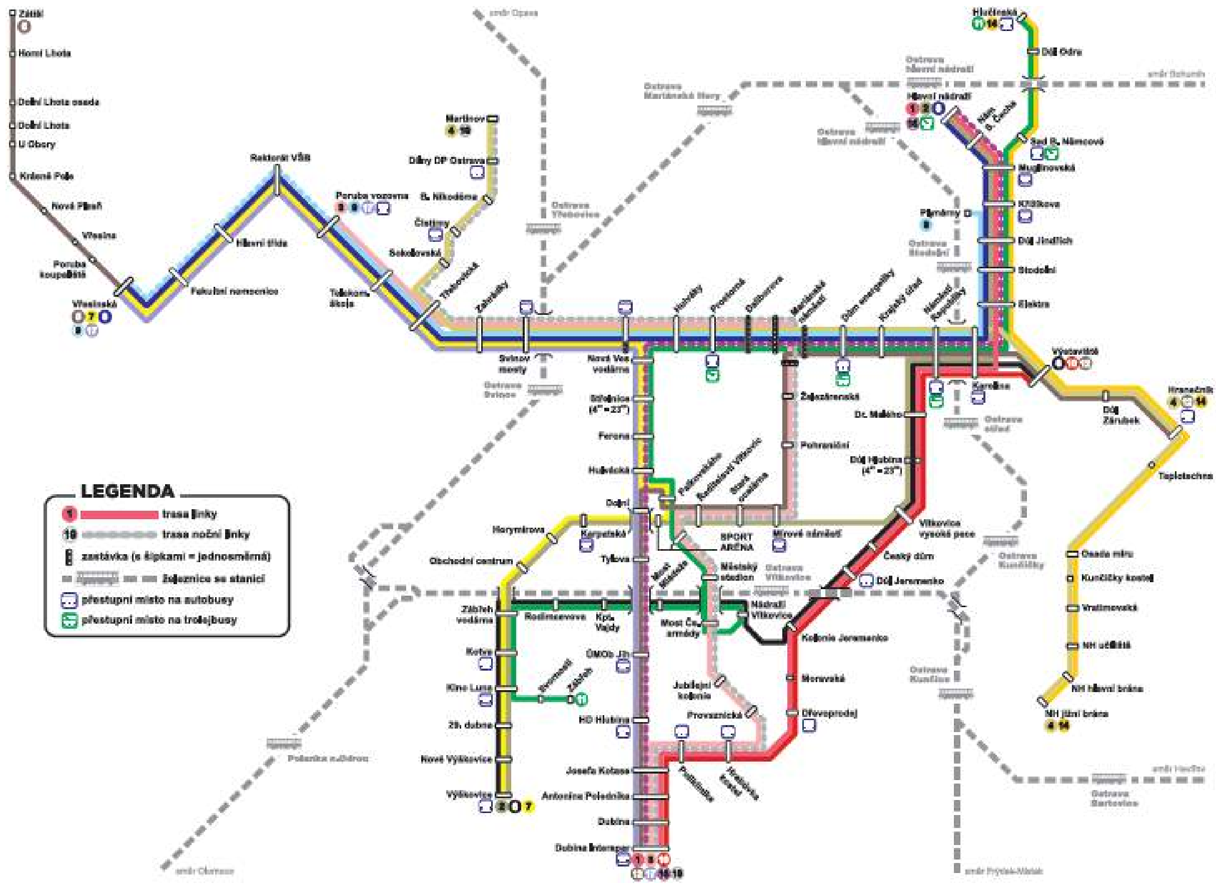

Figure 12 - Scheme of tram lines in Ostrava [14]

The rest of the railway network creates the railway infrastructure administered by Advanced World Transport a.s. company.

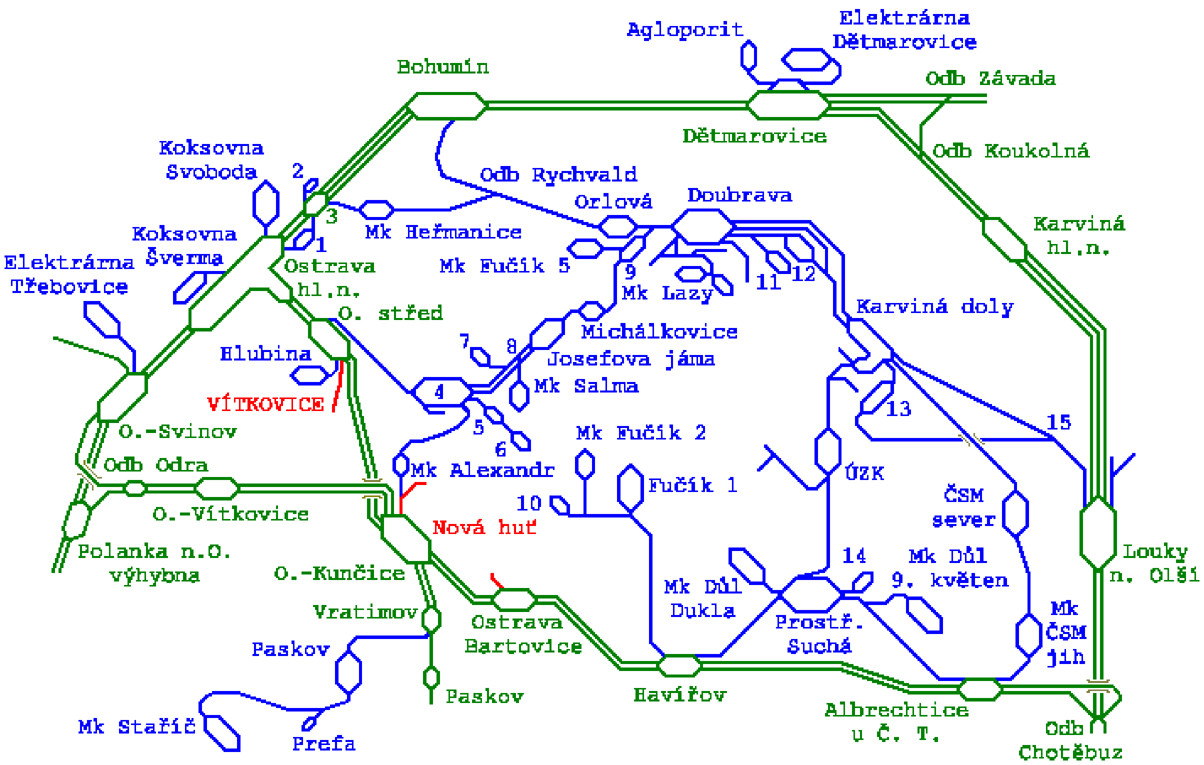

Figure 13 - Railway network administered by Advanced World Transport a.s. (blue lines)

Except for the existing railway network, there are embankments and other earthworks left from the vanished tracks.

Utilization of these relics makes the realization of new railway system easier. This is another big advantage of the Ostrava region with regard to the possible implementation of train-trams.

4.3.4 Urbanization structure

As presented in the previous chapters, the area between Ostrava, Havířov, Český Těšín, Karviná and Bohumín is very specific from urbanization point of view. One aspect is that particular municipalities are very spacious, rarely forming a dense city center, and between each housing estate there is a free area of fields or forests. Another aspect is that such municipalities adjoin each other in a very tight manner. This means there are not any large unsettled areas and the areas are very similar to the ones being laid out between the housing estates.

Such a way of urbanization of an area seems to be very convenient for train-tram systems. Distance of the stops on the track that meets the requirements of train-tram system complies with the distance of housing estates in the area.

4.3.5 Poor transport service

Due to the inexistence of any other type of urban public transport than bus transport, which is very slow, many passengers prefer individual car transport. This would be understandable in smaller municipalities like villages. It is very inconvenient for bigger cities like Orlová or Havířov.[1]

[1] Havířov has a railway connection but the station is located in a very edge of the city, forcing the majority of citizens to use a bus connection or a car to arrive to the station.

5 DESCRIPTION OF PRESENTED ALIGNMENTS OF TRAIN-TRAM LINES IN THE REGION

There are countless options of alignments of train-tram tracks in the region. Only few of them, however, were chosen for closer consideration. The basic idea was to utilize the current infrastructure as much as possible to decrease the initial investments to enable the operation.

5.1 The considered options

Among the considered options were not included variants with completely newly built sections except for short junctions enabling connection of tracks of a reasonable importance for travelers. All sections that were considered for the possible implementation are shown in the following scheme.

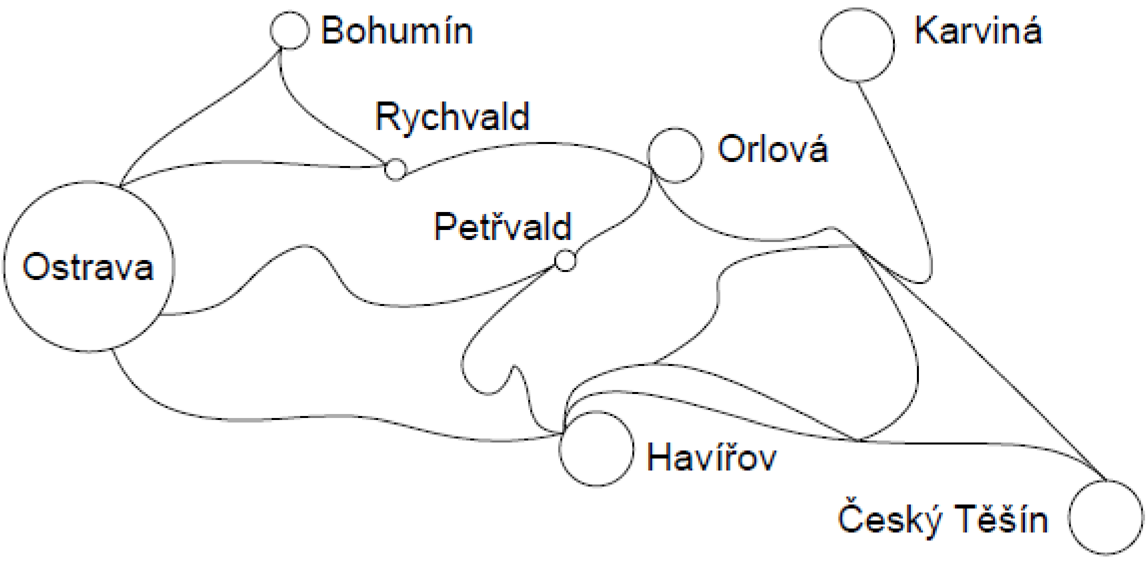

Figure 14 - Scheme of all considered sections of possible implementation of train-trams in the region

Out of the group of sections, three proposed lines were selected. The selected lines cover the major transport streams of the population living in the area. Additionally, it is possible to review and modify the selected lines in the future if the operator evaluates this step as right. Drawings of horizontal alignments of the proposed train-tram lines are in appendix.

5.2 Line types

When a corridor for a line is set, different types of lines can be chosen. Lines can be of a single-track or a double-track type, moreover, with electric traction or diesel traction.

For the presented lines, single-track type was chosen. In compliance with the basic idea of decreasing the initial investments, single-track line type was the more suitable solution. All the existing lines are single-tracks, except for short double-track sections, and reconstruction of the existing single-track lines into double-track ones would demand an important increase in costs. If the operator needed to increase the frequency of connections above limits of proposed infrastructure, a passing loop or more can be built.

Double-track lines would definitely offer higher comfort of train operation, and are necessary to be considered, too; this variant, however, exceeds the scope of this thesis.

Electric traction is a modern and effective way of operating railways. The design of a line in electric and diesel traction, however, differs significantly only in designing of power line, supporting poles and converter stations. On that account, the presented alignments of the tracks were designed as if they were in diesel traction.

5.3 Designed lines description

In this chapter, a detailed description of proposed train-tram lines is presented. Design speed of the first two lines is 80 km per hour; the last proposed line is designed for a design speed of 50 km per hour.

According to the Czech Standards, the design speed of an alignment without spirals is limited to 60 km per hour, however, if a compound curve is used, it is possible to set the speed of 80 km per hour. [16]

The necessity of keeping the limit even for train-tram vehicles remains as a topic for a further research. The vehicles, however, are characterized by a light design, and therefore, their impact on track is not very strong. Due to this reasons, this diploma thesis takes this clause as a premise only and presents a design of horizontal alignments with design speed of 80 km per hour.

5.3.1 Line Ostrava – Rychvald – Orlová – Český Těšín (– Třinec)

This line begins in the Ostrava hlavní nádraží station. Here the train-trams can start or join the train-tram line by arrival from Ostrava-Svinov or another station. A connection to the tram network can be built here, too.

From the station, train-trams continue on the track to Bohumín as far as to Hrušov. In Hrušov, the line turns away from the main track to Bohumín and goes in the southeastern direction. At the same place starts the designed alignment.

After a short straight section, the line turns slightly to the left passing the prison compound in Heřmanice. Behind the prison compound, the line crosses the premises of Heřmanice coal mine and passes the Ostrava-Heřmanice quarter. Then, there comes a left curve before heading right across Vrbická Stružka creek. Behind the next right curve joins the line a track from Bohumín, which used to be the original alignment of Košice – Bohumín railway, in Rychvald junction.

The line continues on an embankment under a bridge of II/470 road. Behind the bridge divides the embankment a pond into two, called Malý Cihelník and Velký Cihelník. Later on continues the line along a bank of Dolní rybník pond before crossing the II/470 road again and the city of Rychvald, too.

Behind Skučák pond and a straight section turns the line slightly to the left crossing ponds named Kališčok, Kout, Prostřední rybník, Dub and Špice on an embankment. The series of ponds is followed by a right curve and the line enters the Orlová city.

After passing the Orlová station and the city centre, the line takes a long left curve to get beneath Osada pod Lipou. Further, the line crosses the compound of Doubrava coal mine and through a defile reaches the Karviná-Doly area. While sludge lagoons are situated on the left hand side, the line takes a right curve into the southeastern direction and aims to the Jan-Karel coal mine. After leaving its premises, the line goes under a bridge of I/59 road and continues over Karvinský creek straight to the old railway station of Karviná.

Behind the old railway station of Karviná, the line continues straight along a sludge lagoon, over Stonávka River and along Darkov coal mine before it reaches the foot of a hill of ČSM-sever coal mine. Under this hill joins the proposed line the main railway line Bohumín – Žilina. Along with this line, train-trams can continue to Český Těšín, or possibly further to Třinec or even Jablunkov – Návsí.

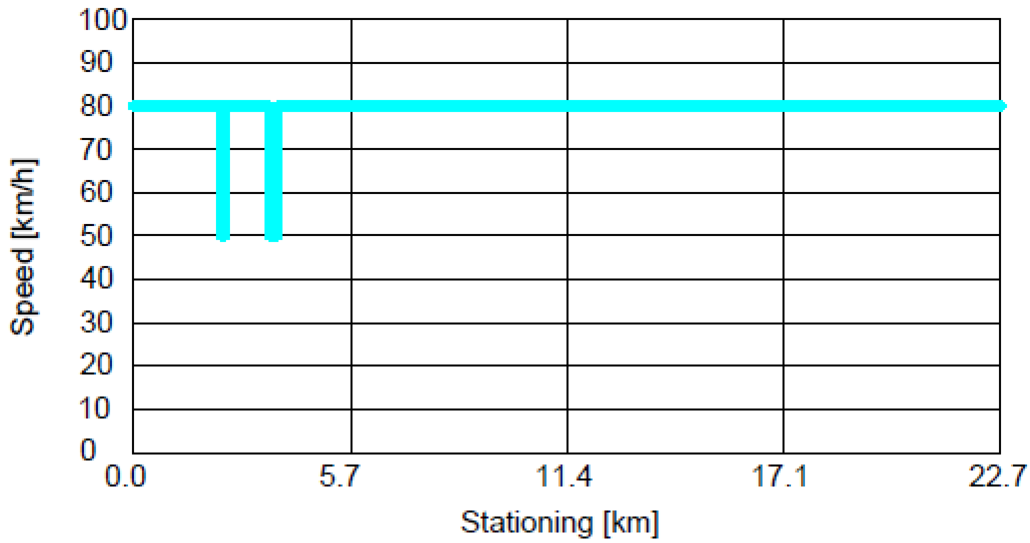

Figure 15 - Speed profile of the line Ostrava – Rychvald – Orlová – Český Těšín (– Třinec)

5.3.2 Line Ostrava – Petřvald – Orlová – Karviná

This line begins in the northern gridiron of railway station Ostrava střed. Here, the alignment diverts eastwards around the New Karolina quarter. A new platform of the station Ostrava střed is designed here. Behind crossing Ostravice River, the line stretches under II/477 road and goes through Zárubek railway yard. The line continues over Lučina River and over tram track Černá Louka – Hranečník. A proposed junction connecting these two lines is a part of the thesis and a drawing of its horizontal alignment is attached to the thesis.

Next to the Jan Maria coal mine, the line turns to the north and goes around Salmovec quarter. Further in the north, the line goes under III/4721 and continues through the railway yard Ostrava-Michálkovice. Behind the railway yard, a long right curve follows and the line takes the southeast direction through Ostrava-Michálkovice quarter. Later, the line enters a forest and goes eastwards leaving the forest not earlier than between Březiny and Kolonie Václav of Petřvald. Behind the following left curve, the line enters the city of Orlová where it goes under II/470 road, firstly, and turns right next to the Žofie coal mine, later. The line passes by the former centre of Orlová city and through a left curve gets under Osada pod Lipou. Further, the line crosses the compound of Doubrava coal mine and through a defile reaches the Karviná-Doly area. While sludge lagoons are situated on the left hand side, the line takes a right curve into the southeastern direction and aims to the Jan-Karel coal mine. After leaving its premises, the line goes under a bridge of I/59 road and continues over Karvinský creek straight to the old railway station of Karviná.

Behind the old railway station of Karviná, the line continues straight along a sludge lagoon, over Stonávka River and along Darkov coal mine. Just beyond level crossing with III/4687 road turns the line sharply to the left joining the main railway line Žilina – Bohumín. Along with this line, train-trams can continue to Karviná, or possibly further to Dětmarovice or Petrovice u Karviné.

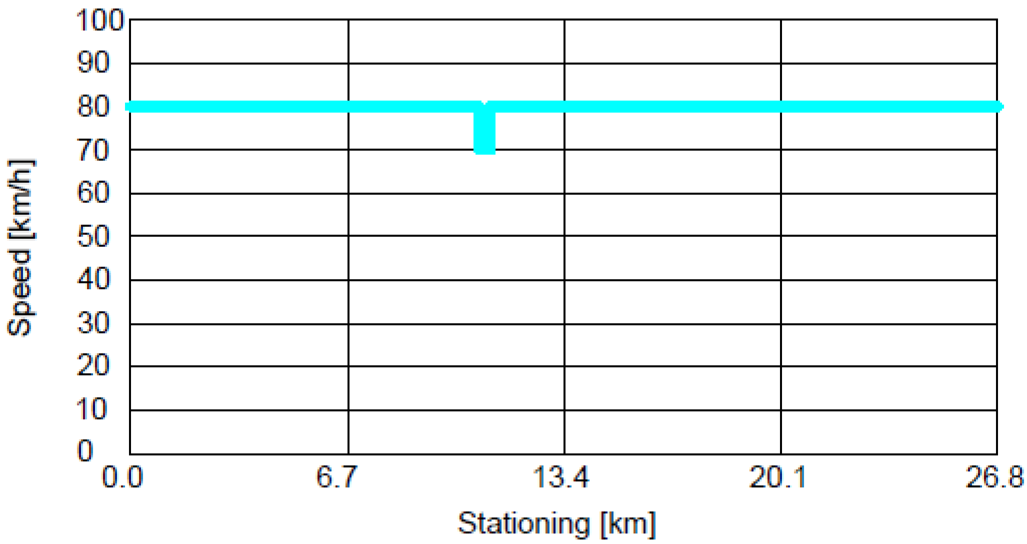

Figure 16 - Speed profile of the line Ostrava – Petřvald – Orlová – Karviná

5.3.3 Line Havířov – Petřvald – Orlová

This line starts with a loop at the very end of Dlouhá Třída Street in Havířov at the edge of Životice village. The line starts out in the northwestern direction, and is led in the central reservation of the street. Going down the Podlesí quarter, the line follows the central axis of the city. The line enters the central reservation of Hlavní Třída Street with a pair of slight right curves on Náměstí Republiky square and continues going in the central axis of the densest part of the city. Just behind Saint Anna church, the line turns to the right on a viaduct that creates an overpass over one of the carriageways of the street.

Not even 100 meters after the viaduct aligns Sušanka River, the viaduct starts turning sharply to the left around Tesco supermarket to join the western gridiron of Havířov railway station. Eastwards from the Havířov railway station, the line diverts to the right and aims to the northeast between Šumbark quarter and Zadky district. Suddenly, the line enters Pežgovský forest. Approximately 2 kilometers later, the line approaches the Pokrok Julius Fučík 1 coal mine. With a sharp left curve, the line gets on an embankment and overpasses II/473 road. The line then continues around Šporovnice quarter of Petřvald and under I/59 road. Subsequently, the line comes near to the Bastro coal mine. The line winds around the city of

Petřvald with a plenty of curves before entering a forest. Further, the line goes eastwards leaving the forest no earlier than between Březiny and Kolonie Václav of Petřvald. Behind the following left curve, the line enters the city of Orlová where it goes under II/470 road, firstly, and goes right through the Žofie coal mine premises, later. Behind the coal mine the line turns to the left to the Orlová railway station. The line rises from the station on a ramp to join III/4747 road after a right turn.

Onwards, the line follows the alignment of the III/4747 road over Orlovská Stružka River and rises through Poruba quarter up the Kozí Hůrka hill. Later, the line continues into Lutyně quarter and terminates there with a loop next to the city hospital of Orlová.

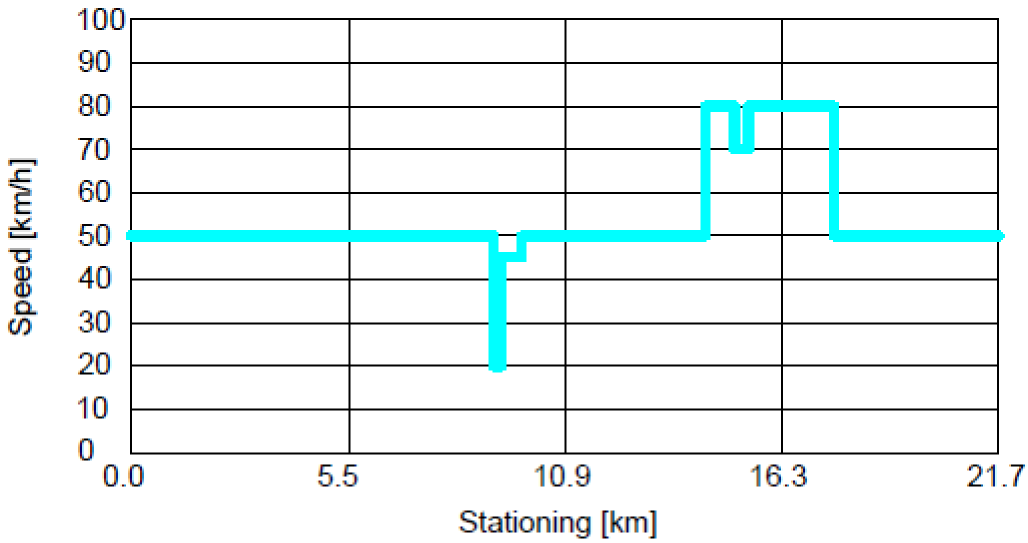

Figure 17 - Speed profile of the line Havířov – Petřvald – Orlová

5.4 Description of significant spots on the lines

In this chapter, a short description of significant spots of the proposed lines is presented.

5.4.1 Hranečník junction

Located on the Ostrava – Petřvald – Orlová – Karviná line, Hranečník junction enables a connection of the proposed line to a tram track in the section Černá Louka – Hranečník. This provides alternative connection to Ostrava střed, Ostrava-Stodolní, Ostrava hlavní nádraží and Ostrava-Svinov stations. According to the Figure 12, train-trams can continue to almost every station in the city of Ostrava through this connection.

Figure 18 - A view of the proposed Hranečník junction; tram tracks in the foreground, designed train-tram line bridge in the background; the connecting track is supposed to be in the wood on the left side

The proposed junction is located in an uninhabited area and covered by wood and bushes only as clearly seen from the picture above. Provided this connection is realized, passengers from Orlová city and other stops in the proposed train-tram network can easily reach tram stops on 28. října and Nádražní streets in the very centre of the city of Ostrava. This results in significant increase of attractiveness of such a network.

5.4.2 Orlová station

Strategic location of the Orlová station provides a useful transfer point for passengers in the area. While one line follows the existing siding that is in the station at the moment, another one approaches the station from the Žofie coal mine direction and continues on a proposed line to reach III/4747 road.

Figure 19 - A view of the Orlová station

5.4.3 Havířov viaduct

An extraordinary construction crosses over the Sušanka River valley. This viaduct helps connect Hlavní Třída street section on one side of the valley with Havířov train station on the opposite side without a single level crossing and without a loss of altitude, providing comfortable infrastructure for train-trams and road vehicles, too.

Figure 20 - A view from the central reservation of Hlavní třída street to the Havířov railway station

The designed line descends less than the surrounding street resulting in gaining mutual difference between altitudes in vertical alignments. As soon as the difference is big enough, the line turns to the right on a viaduct creating an overpass above one of the carriageways of Hlavní Třída Street. The viaduct then continues crossing over the Sušanka River and II/475 road before approaching Havířov train station on the opposite slope of the valley.

Additionally, the viaduct enables a railway connection of Havířov city with the Havířov railway station, which can be for a city of population of nearly 80000 very beneficial.

6 CONCLUSION

6.1 Assets of the designed alignments

As presented in chapter 5, the uniting idea of the thesis was to keep the costs of the designed train-tram network as low as possible. For this reason, the existing railway network and remaining earthworks were used where such an infrastructure endured.

Except for the urban sections of Havířov and Orlová, a short section at the Pokrok Julius Fučík 1 coal mine, Hranečník junction and Karviná-Darkov curve in Ostrava – Petřvald – Orlová – Karviná line, no new construction is needed. Additionally, the short section at the Pokrok Julius Fučík 1 coal mine was chosen only to avoid a zig zag.

The train-tram stops are in a walking distance for a vast majority of Havířov and Orlová citizens. Moreover, railway connections from such train-tram stops can be provided to the city centre of Ostrava offering a valuable alternative not just to bus connections but to car transport, too.

6.2 Estimated costs

According to the budget presented in Appendix C – Brief indicative budget, the estimated costs of the realization of the designed track are 1,335 million Czech crowns. It is important to keep in mind that these costs do not contain signaling, communication equipment and other investments that are necessary to be made until the final step of the project. However, a detailed budget was not a part of this thesis and would lengthen the thesis over reasonable limits.

EPILOGUE

This diploma thesis introduced one of the options how a train-tram network in the Ostrava region, consequently in the Czech Republic, can be implemented. It provides a design of horizontal alignments of a train-tram network with a special accent on costs of the construction. Existing tracks were widely used in the design. This choice, except for decreasing the costs of the construction, makes the design very environmental-friendly.

Historical context was shortly described enabling the reader to get acquainted with the transport situation in the area in past decades. An analysis of local conditions follows in the thesis. A brief summary of actual situation in legislation and standards was presented.

Key parts of the thesis were the summarizing of train-tram specification and demands and a description of the designed solution. There is a larger space dedicated to these chapters in the thesis.

In the appendix, a reader can find information specifying the alignments, a brief indicative budget, photos of the current state of the solved areas and the list of drawings.

In the design, an accent was put on the most modern procedures resulting in usage of a new platform edge H that was introduced in 2013.

The trend in world public transport in the last decades is definitely in placing stops and stations as close to the passengers as possible and in an attempt to carry passengers “from door to door” to compete with the individual car transport. A train-tram system, like the one presented, fulfills both of these attributes very well. Additionally, the Czech Republic has been struggling in building of new tracks for decades (the railway corridors modernization is still “just” a modernization). Apart from the considered construction of a high speed railway, this train-tram network in the Ostrava region can be another hit and improvement of the railway network of the Czech Republic.

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APPENDIX A – TABLE OF CANTS

Line Ostrava – Rychvald – Orlová – Český Těšín (– Třinec)

Cant Curve	Start Station [m]	End Station [m]	Length [m]	Applied Cant (D) [mm]	Equili-brium Cant (D_{eq}) [mm]	Cant Defi-ciency (I) [mm]	Cant Gradi-ent	Vertical Speed [m/s]	Lateral Accele-ration [m/s^2]	Speed [km/h]
Curve.1										
Transition In Region	-13.11	58.89	72.00							80
End Level Rail	-13.11			0.0	0.0	0.0			0.000	80
Begin Full Cant	58.89			150.0	250.0	100.0	0.21%	0.046	0.654	80
Begin Curve	34.89				250.0					80
Transition Out Region	320.39	392.39	72.00							80
End Full Cant	320.39			150.0	250.0	100.0	0.00%	0.000	0.654	80
End Curve	344.39				250.0					80
Begin Level Rail	392.39			0.0	0.0	0.0	-0.21%	-0.046	0.000	80
Curve.2										
Transition In Region	465.81	537.81	72.00							80
End Level Rail	465.81			0.0	0.0	0.0			0.000	80
Begin Full Cant	537.81			150.0	266.0	116.0	0.21%	0.046	0.758	80
Begin Curve	513.81				266.0					80
Transition Out Region	664.94	664.94	72.00							80
End Full Cant	664.94			150.0	266.0	116.0	0.00%	0.000	0.758	80
End Curve	688.94				266.0					80
Begin Level Rail	736.94			0.0	0.0	0.0	-0.21%	-0.046	0.000	80
Curve.3										
Transition In Region	860.97	923.37	62.40							80
End Level Rail	860.97			0.0	0.0	0.0			0.000	80
Begin Full Cant	923.37			130.0	215.8	85.8	0.21%	0.046	0.561	80
Begin Curve	902.57				215.8					80
Transition Out Region	967.23	1029.63	62.40							80
End Full Cant	967.23			130.0	215.8	85.8	0.00%	0.000	0.561	80
End Curve	988.03				215.8					80
Begin Level Rail	1029.63			0.0	0.0	0.0	-0.21%	-0.046	0.000	80

Cant Curve	Start Station [m]	End Station [m]	Length [m]	Applied Cant (D) [mm]	Equilibrium Cant (D_{eq}) [mm]	Cant Deficiency (I) [mm]	Cant Gradient	Vertical Speed [m/s]	Lateral Acceleration [m/s^2]	Speed [km/h]
Curve.4										
Transition In Region	1048.09	1091.77	43.68							80
End Level Rail	1048.09			0.0	0.0	0.0			0.000	80
Begin Full Cant	1091.77			91.0	151.0	60.0	0.21%	0.046	0.393	80
Begin Curve	1077.21				151.0					80
Transition Out Region	1118.66	1191.66	73.00							80
End Full Cant	1118.66			91.0	151.0	60.0	0.00%	0.000	0.393	80
End Curve	1118.66				151.0					80
Begin Level Rail	1191.66			0.0	0.0	0.0	-0.12%	-0.028	0.000	80
Curve.5										
Transition In Region	2061.45	2182.45	121.00							80
End Level Rail	2061.45			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	2182.45			150.0	236.0	86.0	0.12%	0.028	0.562	80
Begin Curve	2141.45				236.0					80
Transition Out Region	2314.47	2386.47	72.00							50
End Full Cant	2314.47			150.0	93.0	-57.0	0.00%	0.000	-0.373	50
End Curve	2386.47				93.0					50
Begin Level Rail	2386.47			0.0	0.0	0.0	-0.21%	-0.029	0.000	50
Curve.6										
Transition In Region	2409.70	2481.70	72.00							50
End Level Rail	2409.70			0.0	0.0	0.0			0.000	50
Begin Full Cant	2481.70			150.0	99.0	-51.0	0.21%	0.029	-0.333	50
Begin Curve	2409.70				99.0					50
Transition Out Region	2545.68	2707.68	121.00							80
End Full Cant	2545.68			150.0	251.7	101.7	0.00%	0.000	0.665	80
End Curve	2586.68				251.7					80
Begin Level Rail	2666.68			0.0	0.0	0.0	-0.12%	-0.028	0.000	80
Curve.7										
Transition In Region	2832.73	2905.73	73.00							80
End Level Rail	2832.73			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	2905.73			91.0	151.0	60.0	0.12%	0.028	0.393	80
Begin Curve	2905.73				151.0					80
Transition Out Region	3016.89	3089.89	73.00							80
End Full Cant	3016.89			91.0	151.0	60.0	0.00%	0.000	0.393	80
End Curve	3016.89				151.0					80
Begin Level Rail	3089.89			0.0	0.0	0.0	-0.12%	-0.028	0.000	80

Cant Curve	Start Station [m]	End Station [m]	Length [m]	Applied Cant (D) [mm]	Equili-brium Cant (D_{eq}) [mm]	Cant Defi-ciency (I) [mm]	Cant Gradi-ent	Vertical Speed [m/s]	Lateral Accele-ration [m/s^2]	Speed [km/h]
Curve.8										
Transition In Region	3225.13	3346.13	121.00							80
End Level Rail	3225.13			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	3346.13			150.0	228.8	78.8	0.12%	0.028	0.515	80
Begin Curve	3305.13				228.8					80
Transition Out Region	3554.53	3626.53	72.00							50
End Full Cant	3554.53			150.0	90.0	-60.0	0.00%	0.000	0.392	50
End Curve	3626.53				90.0					50
Begin Level Rail	3626.53			0.0	0.0	0.0	-0.21%	-0.029	0.000	50
Curve.9										
Transition In Region	3641.92	3680.80	38.88							50
End Level Rail	3641.92			0.0	0.0	0.0			0.000	50
Begin Full Cant	3680.80			81.0	135.0	54.0	0.21%	0.029	0.353	50
Begin Curve	3641.92				135.0					50
Transition Out Region	3719.62	3758.50	38.88							50
End Full Cant	3719.62			81.0	135.0	54.0	0.00%	0.000	0.353	50
End Curve	3732.58				135.0					50
Begin Level Rail	3758.50			0.0	0.0	0.0	-0.21%	-0.029	0.000	50
Curve.10										
Transition In Region	3779.78	3851.78	72.00							50
End Level Rail	3779.78			0.0	0.0	0.0			0.000	50
Begin Full Cant	3851.78			150.0	148.0	-2.0	0.21%	0.029	-0.013	50
Begin Curve	3779.78				148.0					50
Transition Out Region	4032.96	4104.93	72.00							80
End Full Cant	4032.96			150.0	250.0	100.0	0.00%	0.000	0.654	80
End Curve	4056.96				250.0					80
Begin Level Rail	4104.93			0.0	0.0	0.0	-0.21%	-0.046	0.000	80
Curve.11										
Transition In Region	4126.50	4157.70	31.20							80
End Level Rail	4126.50			0.0	0.0	0.0			0.000	80
Begin Full Cant	4157.70			65.0	100.7	35.7	0.21%	0.046	0.233	80
Begin Curve	4147.30				100.7					80
Transition Out Region	4595.71	4647.71	52.00							80
End Full Cant	4595.71			65.0	100.7	35.7	0.00%	0.000	0.233	80
End Curve	4595.71				100.7					80
Begin Level Rail	4647.71			0.0	0.0	0.0	-0.12%	-0.028	0.000	80

Cant Curve	Start Station [m]	End Station [m]	Length [m]	Applied Cant (D) [mm]	Equili-brium Cant (D_{eq}) [mm]	Cant Defi-ciency (I) [mm]	Cant Gradi-ent	Vertical Speed [m/s]	Lateral Accele-ration [m/s^2]	Speed [km/h]
Curve.12										
Transition In Region	5327.85	5347.85	20.00							80
End Level Rail	5327.85			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	5347.85			23.0	37.8	14.8	0.12%	0.026	0.096	80
Begin Curve	5347.85				37.8					80
Transition Out Region	5713.19	5733.19	20.00							80
End Full Cant	5713.19			23.0	37.8	14.8	0.00%	0.000	0.096	80
End Curve	5713.19				37.8					80
Begin Level Rail	5733.19			0.0	0.0	0.0	-0.12%	-0.026	0.000	80
Curve.13										
Transition In Region	6729.62	6774.62	45.00							80
End Level Rail	6729.62			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	6774.62			51.0	79.5	28.5	0.11%	0.025	0.186	80
Begin Curve	6774.62				79.5					80
Transition Out Region	7262.29	7307.29	45.00							80
End Full Cant	7262.29			51.0	79.5	28.5	0.00%	0.000	0.186	80
End Curve	7262.29				79.5					80
Begin Level Rail	7307.29			0.0	0.0	0.0	-0.11%	-0.025	0.000	80
Curve.14										
Transition In Region	8141.55	8167.55	26.00							80
End Level Rail	8141.55			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	8167.55			38.0	62.9	24.9	0.15%	0.032	0.163	80
Begin Curve	8167.55				62.9					80
Transition Out Region	8566.90	8592.90	26.00							80
End Full Cant	8566.90			38.0	62.9	24.9	0.00%	0.000	0.163	80
End Curve	8566.90				62.9					80
Begin Level Rail	8592.90			0.0	0.0	0.0	-0.15%	-0.032	0.000	80
Curve.15										
Transition In Region	9080.74	9125.74	45.00							80
End Level Rail	9080.74			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	9125.74			51.0	78.7	27.7	0.11%	0.025	0.181	80
Begin Curve	9125.74				78.7					80
Transition Out Region	9825.43	9870.43	45.00							80
End Full Cant	9825.43			51.0	78.7	27.7	0.00%	0.000	0.181	80
End Curve	9825.43				78.7					80
Begin Level Rail	9870.43			0.0	0.0	0.0	-0.11%	-0.025	0.000	80

Cant Curve	Start Station [m]	End Station [m]	Length [m]	Applied Cant (D) [mm]	Equili-brium Cant (D_{eq}) [mm]	Cant Defi-ciency (I) [mm]	Cant Gradi-ent	Vertical Speed [m/s]	Lateral Accele-ration [m/s^2]	Speed [km/h]
Curve.16										
Transition In Region	10921.18	10982.18	61.00							80
End Level Rail	10921.18			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	10982.18			77.0	116.2	39.2	0.13%	0.028	0.256	80
Begin Curve	10982.18				116.2					80
Transition Out Region	11725.45	11786.45	61.00							80
End Full Cant	11725.45			77.0	116.2	39.2	0.00%	0.000	0.256	80
End Curve	11725.45				116.2					80
Begin Level Rail	11786.45			0.0	0.0	0.0	-0.13%	-0.028	0.000	80
Curve.17										
Transition In Region	12279.20	12305.20	26.00							80
End Level Rail	12279.20			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	12305.20			38.0	58.1	20.1	0.15%	0.032	0.131	80
Begin Curve	12305.20				58.1					80
Transition Out Region	12747.42	12765.66	18.24							80
End Full Cant	12747.42			38.0	58.1	20.1	0.00%	0.000	0.131	80
End Curve	12765.66				58.1					80
Begin Level Rail	12765.66			0.0	0.0	0.0	-0.21%	-0.046	0.000	80
Curve.18										
Transition In Region	12791.58	12718.94	27.36							80
End Level Rail	12791.58			0.0	0.0	0.0			0.000	80
Begin Full Cant	12718.94			57.0	94.4	37.4	0.21%	0.046	0.245	80
Begin Curve	12791.58				94.4					80
Transition Out Region	12924.40	12969.40	45.00							80
End Full Cant	12924.40			57.0	94.4	37.4	0.00%	0.000	0.245	80
End Curve	12924.40				94.4					80
Begin Level Rail	12969.40			0.0	0.0	0.0	-0.13%	-0.028	0.000	80
Curve.19										
Transition In Region	12990.97	13026.97	36.00							80
End Level Rail	12990.97			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	13026.97			45.0	75.5	30.5	0.12%	0.028	0.200	80
Begin Curve	13026.97				75.5					80
Transition Out Region	13184.43	13220.43	36.00							80
End Full Cant	13184.43			45.0	75.5	30.5	0.00%	0.000	0.200	80
End Curve	13196.43				75.5					80
Begin Level Rail	13220.43			0.0	0.0	0.0	-0.12%	-0.028	0.000	80

Cant Curve	Start Station [m]	End Station [m]	Length [m]	Applied Cant (D) [mm]	Equilibrium Cant (D_{eq}) [mm]	Cant Deficiency (I) [mm]	Cant Gradient	Vertical Speed [m/s]	Lateral Acceleration [m/s^2]	Speed [km/h]
Curve.20										
Transition In Region	13241.12	13277.12	36.00							80
End Level Rail	13241.12			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	13277.12			45.0	75.5	30.5	0.12%	0.028	0.200	80
Begin Curve	13277.12				75.5					80
Transition Out Region	13400.85	13436.85	36.00							80
End Full Cant	13400.85			45.0	75.5	30.5	0.00%	0.000	0.200	80
End Curve	13400.85				75.5					80
Begin Level Rail	13436.85			0.0	0.0	0.0	-0.12%	-0.028	0.000	80
Curve.21										
Transition In Region	13521.43	13602.43	81.00							80
End Level Rail	13521.43			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	13602.43			101.0	164.2	63.2	0.12%	0.028	0.413	80
Begin Curve	13575.43				164.2					80
Transition Out Region	13807.70	13888.70	81.00							80
End Full Cant	13807.70			101.0	164.2	63.2	0.00%	0.000	0.413	80
End Curve	13834.70				164.2					80
Begin Level Rail	13888.70			0.0	0.0	0.0	-0.12%	-0.028	0.000	80
Curve.22										
Transition In Region	14383.77	14419.77	36.00							80
End Level Rail	14383.77			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	14419.77			45.0	71.9	26.9	0.12%	0.028	0.176	80
Begin Curve	14419.77				71.9					80
Transition Out Region	14662.07	14698.07	36.00							80
End Full Cant	14662.07			45.0	71.9	26.9	0.00%	0.000	0.176	80
End Curve	14662.07				71.9					80
Begin Level Rail	14698.07			0.0	0.0	0.0	-0.12%	-0.028	0.000	80
Curve.23										
Transition In Region	15071.38	15094.38	23.00							80
End Level Rail	15071.38			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	15094.38			32.0	52.1	20.1	0.14%	0.031	0.131	80
Begin Curve	15094.38				52.1					80
Transition Out Region	15741.67	15764.67	23.00							80
End Full Cant	15741.67			32.0	52.1	20.1	0.00%	0.000	0.131	80
End Curve	15741.67				52.1					80
Begin Level Rail	15764.67			0.0	0.0	0.0	-0.14%	-0.031	0.000	80

Cant Curve	Start Station [m]	End Station [m]	Length [m]	Applied Cant (D) [mm]	Equili-brium Cant (D_{eq}) [mm]	Cant Defi-ciency (I) [mm]	Cant Gradi-ent	Vertical Speed [m/s]	Lateral Accele-ration [m/s^2]	Speed [km/h]
Curve.24										
Transition In Region	16005.68	16041.68	36.00							80
End Level Rail	16005.68			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	16041.68			45.0	75.5	30.5	0.12%	0.028	0.200	80
Begin Curve	16041.68				75.5					80
Transition Out Region	16232.14	16268.14	36.00							80
End Full Cant	16232.14			45.0	75.5	30.5	0.00%	0.000	0.200	80
End Curve	16232.14				75.5					80
Begin Level Rail	16268.14			0.0	0.0	0.0	-0.12%	-0.028	0.000	80
Curve.25										
Transition In Region	20148.84	20193.84	45.00							80
End Level Rail	20148.84			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	20193.84			57.0	88.8	31.8	0.13%	0.028	0.208	80
Begin Curve	20193.84				88.8					80
Transition Out Region	20447.18	20492.18	45.00							80
End Full Cant	20447.18			57.0	88.8	31.8	0.00%	0.000	0.208	80
End Curve	20447.18				88.8					80
Begin Level Rail	20492.18			0.0	0.0	0.0	-0.13%	-0.028	0.000	80

Line Ostrava – Petřvald – Orlová – Karviná

Cant Curve	Start Station [m]	End Station [m]	Length [m]	Applied Cant (D) [mm]	Equili-brium Cant (D_{eq}) [mm]	Cant Defi-ciency (I) [mm]	Cant Gradi-ent	Vertical Speed [m/s]	Lateral Accele-ration [m/s^2]	Speed [km/h]
Curve.26										
Transition In Region	-51.40	69.60	121.00							80
End Level Rail	-51.40			0.0	0.0	0.0			0.000	80
Begin Curve	29.27				243.6					80
Begin Full Cant	69.60			150.0	243.6	93.6	0.12%	0.028	0.612	80
Transition Out Region	432.54	553.54	121.00							80
End Full Cant	432.54			150.0	243.6	93.6	0.00%	0.000	0.612	80
End Curve	472.87				243.6					80
Begin Level Rail	553.54			0.0	0.0	0.0	-0.12%	-0.028	0.000	80

Cant Curve	Start Station [m]	End Station [m]	Length [m]	Applied Cant (D) [mm]	Equili-brium Cant (D_{eq}) [mm]	Cant Defi-ciency (I) [mm]	Cant Gradi-ent	Vertical Speed [m/s]	Lateral Accele-ration [m/s^2]	Speed [km/h]
Curve.27										
Transition In Region	845.99	918.99	73.00							80
End Level Rail	845.99			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	918.99			91.0	151.0	60.0	0.12%	0.028	0.393	80
Begin Curve	918.99				151.0					80
Transition Out Region	950.69	1023.69	73.00							80
End Full Cant	950.69			91.0	151.0	60.0	0.00%	0.000	0.393	80
End Curve	950.69				151.0					80
Begin Level Rail	1023.69			0.0	0.0	0.0	-0.12%	-0.028	0.000	80
Curve.28										
Transition In Region	1100.51	1173.51	73.00							80
End Level Rail	1100.51			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	1173.51			91.0	151.0	60.0	0.12%	0.028	0.393	80
Begin Curve	1173.51				151.0					80
Transition Out Region	1193.31	1266.31	73.00							80
End Full Cant	1193.31			91.0	151.0	60.0	0.00%	0.000	0.393	80
End Curve	1193.31				151.0					80
Begin Level Rail	1266.31			0.0	0.0	0.0	-0.12%	-0.028	0.000	80
Curve.29										
Transition In Region	2006.43	2051.43	45.00							80
End Level Rail	2006.43			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	2051.43			57.0	94.4	37.4	0.13%	0.028	0.245	80
Begin Curve	2051.43				94.4					80
Transition Out Region	2219.81	2264.81	45.00							80
End Full Cant	2219.81			57.0	94.4	37.4	0.00%	0.000	0.245	80
End Curve	2234.81				94.4					80
Begin Level Rail	2264.81			0.0	0.0	0.0	-0.13%	-0.028	0.000	80
Curve.30										
Transition In Region	2293.66	2338.66	45.00							80
End Level Rail	2293.66			0.0	0.0	0.0			0.000	80
Begin Full Cant	2338.66			51.0	83.9	32.9	0.11%	0.025	0.215	80
Begin Curve	2323.66				83.9					80
Transition Out Region	2471.02	2516.02	45.00							80
End Full Cant	2471.02			51.0	83.9	32.9	0.00%	0.000	0.215	80
End Curve	2471.02				83.9					80
Begin Level Rail	2516.02			0.0	0.0	0.0	-0.11%	-0.025	0.000	80

Cant Curve	Start Station [m]	End Station [m]	Length [m]	Applied Cant (D) [mm]	Equili-brium Cant (D_{eq}) [mm]	Cant Defi-ciency (I) [mm]	Cant Gradi-ent	Vertical Speed [m/s]	Lateral Accele-ration [m/s^2]	Speed [km/h]
Curve.31										
Transition In Region	2910.46	3013.46	103.00							80
End Level Rail	2910.46			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	3013.46			130.0	204.1	74.1	0.13%	0.028	0.485	80
Begin Curve	2979.13				204.1					80
Transition Out Region	3486.54	3589.54	103.00							80
End Full Cant	3486.54			130.0	204.1	74.1	0.00%	0.000	0.485	80
End Curve	3520.87				204.1					80
Begin Level Rail	3589.54			0.0	0.0	0.0	-0.13%	-0.028	0.000	80
Curve.32										
Transition In Region	3702.97	3805.97	103.00							80
End Level Rail	3702.97			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	3805.97			130.0	204.1	74.1	0.13%	0.028	0.485	80
Begin Curve	3771.64				204.1					80
Transition Out Region	3973.69	4057.05	84.00							80
End Full Cant	3973.69			130.0	204.1	74.1	0.00%	0.000	0.485	80
End Curve	4001.69				204.1					80
Begin Level Rail	4057.05			0.0	0.0	0.0	-0.15%	-0.034	0.000	80
Curve.33										
Transition In Region	4080.55	4132.55	52.00							80
End Level Rail	4080.55			0.0	0.0	0.0			0.000	80
Begin Full Cant	4132.55			65.0	107.9	42.9	0.13%	0.028	0.280	80
Begin Curve	4115.21				107.9					80
Transition Out Region	4440.84	4492.84	52.00							80
End Full Cant	4440.84			65.0	107.9	42.9	0.00%	0.000	0.280	80
End Curve	4440.84				107.9					80
Begin Level Rail	4492.84			0.0	0.0	0.0	-0.12%	-0.028	0.000	80
Curve.34										
Transition In Region	4689.05	4810.05	121.00							80
End Level Rail	4689.05			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	4810.05			150.0	251.7	101.7	0.12%	0.028	0.665	80
Begin Curve	4769.71				251.7					80
Transition Out Region	4826.59	4947.59	121.00							80
End Full Cant	4826.59			150.0	251.7	101.7	0.00%	0.000	0.665	80
End Curve	4866.93				251.7					80
Begin Level Rail	4947.59			0.0	0.0	0.0	-0.12%	-0.028	0.000	80

Cant Curve	Start Station [m]	End Station [m]	Length [m]	Applied Cant (D) [mm]	Equilibrium Cant (D_{eq}) [mm]	Cant Deficiency (I) [mm]	Cant Gradient	Vertical Speed [m/s]	Lateral Acceleration [m/s^2]	Speed [km/h]
Curve.35										
Transition In Region	5168.13	5188.13	20.00							80
End Level Rail	5168.13			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	5188.13			23.0	37.8	14.8	0.12%	0.026	0.096	80
Begin Curve	5188.13				37.8					80
Transition Out Region	5421.53	5441.53	20.00							80
End Full Cant	5421.53			23.0	37.8	14.8	0.00%	0.000	0.096	80
End Curve	5421.53				37.8					80
Begin Level Rail	5441.53			0.0	0.0	0.0	-0.12%	-0.026	0.000	80
Curve.36										
Transition In Region	5694.89	5797.89	103.00							80
End Level Rail	5694.89			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	5797.89			130.0	198.7	68.7	0.13%	0.028	0.449	80
Begin Curve	5763.55				198.7					80
Transition Out Region	6456.30	6559.30	103.00							80
End Full Cant	6456.30			130.0	198.7	68.7	0.00%	0.000	0.449	80
End Curve	6490.64				198.7					80
Begin Level Rail	6559.30			0.0	0.0	0.0	-0.13%	-0.028	0.000	80
Curve.37										
Transition In Region	7208.66	7289.66	81.00							80
End Level Rail	7208.66			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	7289.66			101.0	160.7	59.7	0.12%	0.028	0.390	80
Begin Curve	7262.66				160.7					80
Transition Out Region	7468.07	7549.07	81.00							80
End Full Cant	7468.07			101.0	160.7	59.7	0.00%	0.000	0.390	80
End Curve	7495.07				160.7					80
Begin Level Rail	7549.07			0.0	0.0	0.0	-0.12%	-0.028	0.000	80
Curve.38										
Transition In Region	7579.00	7640.00	61.00							80
End Level Rail	7579.00			0.0	0.0	0.0			0.000	80
Begin Full Cant	7640.00			77.0	125.9	48.9	0.13%	0.028	0.319	80
Begin Curve	7619.66				125.9					80
Transition Out Region	7851.38	7912.38	61.00							80
End Full Cant	7851.38			77.0	125.9	48.9	0.00%	0.000	0.319	80
End Curve	7851.38				125.9					80
Begin Level Rail	7912.38			0.0	0.0	0.0	-0.13%	-0.028	0.000	80

Cant Curve	Start Station [m]	End Station [m]	Length [m]	Applied Cant (D) [mm]	Equili-brium Cant (D_{eq}) [mm]	Cant Defi-ciency (I) [mm]	Cant Gradi-ent	Vertical Speed [m/s]	Lateral Accele-ration [m/s^2]	Speed [km/h]
Curve.39										
Transition In Region	7958.05	8061.05	103.00							80
End Level Rail	7958.05			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	8061.05			130.0	198.7	68.7	0.13%	0.028	0.449	80
Begin Curve	8026.71				198.7					80
Transition Out Region	8263.49	8366.49	103.00							80
End Full Cant	8263.49			130.0	198.7	68.7	0.00%	0.000	0.449	80
End Curve	8297.83				198.7					80
Begin Level Rail	8366.49			0.0	0.0	0.0	-0.13%	-0.028	0.000	80
Curve.40										
Transition In Region	8500.58	8561.58	61.00							80
End Level Rail	8500.58			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	8561.58			77.0	111.1	34.1	0.13%	0.028	0.223	80
Begin Curve	8561.58				111.1					80
Transition Out Region	8677.17	8727.17	50.00							80
End Full Cant	8677.17			77.0	111.1	34.1	0.00%	0.000	0.223	80
End Curve	8693.84				111.1					80
Begin Level Rail	8727.17			0.0	0.0	0.0	-0.15%	-0.034	0.000	80
Curve.41										
Transition In Region	8745.50	8818.50	73.00							80
End Level Rail	8745.50			0.0	0.0	0.0			0.000	80
Begin Full Cant	8818.50			91.0	151.0	60.0	0.12%	0.028	0.393	80
Begin Curve	8794.16				151.0					80
Transition Out Region	8963.58	9022.58	59.00							80
End Full Cant	8963.58			91.0	151.0	60.0	0.00%	0.000	0.393	80
End Curve	8983.25				151.0					80
Begin Level Rail	9022.58			0.0	0.0	0.0	-0.15%	-0.034	0.000	80
Curve.42										
Transition In Region	9038.79	9130.79	92.00							80
End Level Rail	9038.79			0.0	0.0	0.0			0.000	80
Begin Full Cant	9130.79			114.0	175.6	61.6	0.12%	0.028	0.403	80
Begin Curve	9100.12				175.6					80
Transition Out Region	9300.66	9355.66	55.00							80
End Full Cant	9300.66			114.0	175.6	61.6	0.00%	0.000	0.403	80
End Curve	9348.66				175.6					80
Begin Level Rail	9355.66			0.0	0.0	0.0	-0.21%	-0.046	0.000	80

Cant Curve	Start Station [m]	End Station [m]	Length [m]	Applied Cant (D) [mm]	Equili-brium Cant (D_{eq}) [mm]	Cant Defi-ciency (I) [mm]	Cant Gradi-ent	Vertical Speed [m/s]	Lateral Accele-ration [m/s^2]	Speed [km/h]
Curve.43										
Transition In Region	9378.85	9433.85	55.00							80
End Level Rail	9378.85			0.0	0.0	0.0			0.000	80
Begin Full Cant	9433.85			114.0	175.6	61.6	0.21%	0.046	0.403	80
Begin Curve	9385.85				175.6					80
Transition Out Region	9522.32	9613.32	91.00							80
End Full Cant	9522.32			114.0	175.6	61.6	0.00%	0.000	0.403	80
End Curve	9552.66				175.6					80
Begin Level Rail	9613.32			0.0	0.0	0.0	-0.13%	-0.028	0.000	80
Curve.44										
Transition In Region	9757.36	9818.36	61.00							80
End Level Rail	9757.36			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	9818.36			77.0	125.9	48.9	0.13%	0.028	0.319	80
Begin Curve	9818.36				125.9					80
Transition Out Region	9986.73	10047.73	61.00							80
End Full Cant	9986.73			77.0	125.9	48.9	0.00%	0.000	0.319	80
End Curve	9986.73				125.9					80
Begin Level Rail	10047.73			0.0	0.0	0.0	-0.13%	-0.028	0.000	80
Curve.45										
Transition In Region	10128.29	10219.29	91.00							80
End Level Rail	10128.29			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	10219.29			114.0	175.6	61.6	0.13%	0.028	0.403	80
Begin Curve	10188.95				175.6					80
Transition Out Region	10541.42	10632.42	91.00							80
End Full Cant	10541.42			114.0	175.6	61.6	0.00%	0.000	0.403	80
End Curve	10571.76				175.6					80
Begin Level Rail	10632.42			0.0	0.0	0.0	-0.13%	-0.028	0.000	80
Curve.46										
Transition In Region	10769.78	10885.78	116.00							70
End Level Rail	10769.78			0.0	0.0	0.0	0.00%	0.000	0.000	70
Begin Full Cant	10885.78			145.0	241.0	96.0	0.13%	0.024	0.628	70
Begin Curve	10847.11				241.0					70
Transition Out Region	11002.46	11118.46	116.00							70
End Full Cant	11002.46			145.0	241.0	96.0	0.00%	0.000	0.628	70
End Curve	11041.13				241.0					70
Begin Level Rail	11118.46			0.0	0.0	0.0	-0.13%	-0.024	0.000	70

Cant Curve	Start Station [m]	End Station [m]	Length [m]	Applied Cant (D) [mm]	Equili-brium Cant (D_{eq}) [mm]	Cant Defi-ciency (I) [mm]	Cant Gradi-ent	Vertical Speed [m/s]	Lateral Accele-ration [m/s^2]	Speed [km/h]
Curve.47										
Transition In Region	11735.15	11808.15	73.00							80
End Level Rail	11735.15			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	11808.15			91.0	142.5	51.5	0.12%	0.028	0.337	80
Begin Curve	11808.15				142.5					80
Transition Out Region	12287.60	12360.60	73.00							80
End Full Cant	12287.60			91.0	142.5	51.5	0.00%	0.000	0.337	80
End Curve	12287.60				142.5					80
Begin Level Rail	12360.60			0.0	0.0	0.0	-0.12%	-0.028	0.000	80
Curve.48										
Transition In Region	12805.56	12908.56	103.00							80
End Level Rail	12805.56			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	12908.56			130.0	193.6	63.6	0.13%	0.028	0.416	80
Begin Curve	12884.22				193.6					80
Transition Out Region	13385.52	13488.52	103.00							80
End Full Cant	13385.52			130.0	193.6	63.6	0.00%	0.000	0.416	80
End Curve	13419.86				193.6					80
Begin Level Rail	13488.52			0.0	0.0	0.0	-0.13%	-0.028	0.000	80
Curve.49										
Transition In Region	13763.86	13808.86	45.00							80
End Level Rail	13763.86			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	13808.86			57.0	94.4	37.4	0.13%	0.028	0.245	80
Begin Curve	13808.86				94.4					80
Transition Out Region	14475.86	14520.86	45.00							80
End Full Cant	14475.86			57.0	94.4	37.4	0.00%	0.000	0.245	80
End Curve	14475.86				94.4					80
Begin Level Rail	14520.86			0.0	0.0	0.0	-0.13%	-0.028	0.000	80
Curve.50										
Transition In Region	15022.39	15048.39	26.00							80
End Level Rail	15022.39			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	15048.39			38.0	58.1	20.1	0.15%	0.032	0.131	80
Begin Curve	15048.39				58.1					80
Transition Out Region	15483.95	15483.95	26.00							80
End Full Cant	15483.95			38.0	58.1	20.1	0.00%	0.000	0.131	80
End Curve	15509.95				58.1					80
Begin Level Rail	15483.95			0.0	0.0	0.0	-0.15%	-0.032	0.000	80

Cant Curve	Start Station [m]	End Station [m]	Length [m]	Applied Cant (D) [mm]	Equilibrium Cant (D_{eq}) [mm]	Cant Deficiency (I) [mm]	Cant Gradient	Vertical Speed [m/s]	Lateral Acceleration [m/s^2]	Speed [km/h]
Curve.51										
Transition In Region	15535.30	15580.30	45.00							80
End Level Rail	15535.30			0.0	0.0	0.0			0.000	80
Begin Full Cant	15580.30			57.0	94.4	37.4	0.13%	0.028	0.245	80
Begin Curve	15535.30				94.4					80
Transition Out Region	15668.13	15713.13	45.00							80
End Full Cant	15668.13			57.0	94.4	37.4	0.00%	0.000	0.245	80
End Curve	15668.13				94.4					80
Begin Level Rail	15713.13			0.0	0.0	0.0	-0.13%	-0.028	0.000	80
Curve.52										
Transition In Region	15734.69	15770.69	36.00							80
End Level Rail	15734.69			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	15770.69			45.0	75.5	30.5	0.12%	0.028	0.200	80
Begin Curve	15770.69				75.5					80
Transition Out Region	15928.15	15964.15	36.00							80
End Full Cant	15928.15			45.0	75.5	30.5	0.00%	0.000	0.200	80
End Curve	15940.15				75.5					80
Begin Level Rail	15964.15			0.0	0.0	0.0	-0.12%	-0.028	0.000	80
Curve.53										
Transition In Region	15984.85	16020.85	36.00							80
End Level Rail	15984.85			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	16020.85			45.0	75.5	30.5	0.12%	0.028	0.200	80
Begin Curve	16020.85				75.5					80
Transition Out Region	16144.58	16180.58	36.00							80
End Full Cant	16144.58			45.0	75.5	30.5	0.00%	0.000	0.200	80
End Curve	16144.58				75.5					80
Begin Level Rail	16180.58			0.0	0.0	0.0	-0.12%	-0.028	0.000	80
Curve.54										
Transition In Region	16265.15	16346.15	81.00							80
End Level Rail	16265.15			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	16346.15			101.0	164.2	63.2	0.12%	0.028	0.413	80
Begin Curve	16319.15				164.2					80
Transition Out Region	16551.42	16632.42	81.00							80
End Full Cant	16551.42			101.0	164.2	63.2	0.00%	0.000	0.413	80
End Curve	16578.42				164.2					80
Begin Level Rail	16632.42			0.0	0.0	0.0	-0.12%	-0.028	0.000	80

Cant Curve	Start Station [m]	End Station [m]	Length [m]	Applied Cant (D) [mm]	Equilibrium Cant (D_{eq}) [mm]	Cant Deficiency (I) [mm]	Cant Gradient	Vertical Speed [m/s]	Lateral Acceleration [m/s^2]	Speed [km/h]
Curve.55										
Transition In Region	17127.49	17163.49	36.00							80
End Level Rail	17127.49			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	17163.49			45.0	71.9	26.9	0.12%	0.028	0.176	80
Begin Curve	17163.49				71.9					80
Transition Out Region	17405.80	17441.80	36.00							80
End Full Cant	17405.80			45.0	71.9	26.9	0.00%	0.000	0.176	80
End Curve	17405.80				71.9					80
Begin Level Rail	17441.80			0.0	0.0	0.0	-0.12%	-0.028	0.000	80
Curve.56										
Transition In Region	17815.10	17838.10	23.00							80
End Level Rail	17815.10			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	17838.10			32.0	52.1	20.1	0.14%	0.031	0.131	80
Begin Curve	17838.10				52.1					80
Transition Out Region	18485.39	18508.39	23.00							80
End Full Cant	18485.39			32.0	52.1	20.1	0.00%	0.000	0.131	80
End Curve	18485.39				52.1					80
Begin Level Rail	18508.39			0.0	0.0	0.0	-0.14%	-0.031	0.000	80
Curve.57										
Transition In Region	18749.39	18785.39	36.00							80
End Level Rail	18749.39			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	18785.39			45.0	75.5	30.5	0.12%	0.028	0.200	80
Begin Curve	18785.39				75.5					80
Transition Out Region	18975.87	19011.87	36.00							80
End Full Cant	18975.87			45.0	75.5	30.5	0.00%	0.000	0.200	80
End Curve	18975.87				75.5					80
Begin Level Rail	19011.87			0.0	0.0	0.0	-0.12%	-0.028	0.000	80
Curve.58										
Transition In Region	21966.03	22091.03	125.00							80
End Level Rail	21966.03			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	22091.03			150.0	269.7	119.7	0.12%	0.027	0.783	80
Begin Curve	22049.36				269.7					80
Transition Out Region	22707.49	22832.49	125.00							80
End Full Cant	22707.49			150.0	269.7	119.7	0.00%	0.000	0.783	80
End Curve	22749.16				269.7					80
Begin Level Rail	22832.49			0.0	0.0	0.0	-0.12%	-0.027	0.000	80

Line Havířov – Petřvald – Orlová

Cant Curve	Start Station [m]	End Station [m]	Length [m]	Applied Cant (D) [mm]	Equili-brium Cant (D_{eq}) [mm]	Cant Defi-ciency (I) [mm]	Cant Gradi-ent	Vertical Speed [m/s]	Lateral Accele-ration [m/s^2]	Speed [km/h]
Curve.59										
Transition In Region	104.94	124.94	20.00							50
End Level Rail	104.94			0.0	0.0	0.0	0.00%	0.000	0.000	50
Begin Full Cant	124.94			0.0	19.7	19.7	0.00%	0.000	0.129	50
Begin Curve	124.94				19.7					50
Transition Out Region	260.83	280.83	20.00							50
End Full Cant	260.83			0.0	19.7	19.7	0.00%	0.000	0.129	50
End Curve	260.83				19.7					50
Begin Level Rail	280.83			0.0	0.0	0.0	0.00%	0.000	0.000	50
Curve.60										
Transition In Region	2244.90	2264.90	20.00							50
End Level Rail	2244.90			0.0	0.0	0.0	0.00%	0.000	0.000	50
Begin Full Cant	2264.90			0.0	29.5	29.5	0.00%	0.000	0.193	50
Begin Curve	2264.90				29.5					50
Transition Out Region	2423.35	2443.35	20.00							50
End Full Cant	2423.35			0.0	29.5	29.5	0.00%	0.000	0.193	50
End Curve	2423.35				29.5					50
Begin Level Rail	2443.35			0.0	0.0	0.0	0.00%	0.000	0.000	50
Curve.61										
Transition In Region	2540.87	2560.87	20.00							50
End Level Rail	2540.87			0.0	0.0	0.0	0.00%	0.000	0.000	50
Begin Full Cant	2560.87			30.0	49.2	19.2	0.15%	0.021	0.125	50
Begin Curve	2560.87				49.2					50
Transition Out Region	2697.70	2717.70	20.00							50
End Full Cant	2697.70			30.0	49.2	19.2	0.00%	0.000	0.125	50
End Curve	2697.70				49.2					50
Begin Level Rail	2717.70			0.0	0.0	0.0	-0.15%	-0.021	0.000	50
Curve.62										
Transition In Region	3740.58	3785.58	45.00							50
End Level Rail	3740.58			0.0	0.0	0.0	0.00%	0.000	0.000	50
Begin Full Cant	3785.58			89.0	147.5	58.5	0.20%	0.027	0.382	50
Begin Curve	3785.58				147.5					50
Transition Out Region	4219.81	4264.81	45.00							50
End Full Cant	4219.81			89.0	147.5	58.5	0.00%	0.000	0.382	50
End Curve	4234.81				147.5					50
Begin Level Rail	4264.81			0.0	0.0	0.0	-0.20%	-0.027	0.000	50

Cant Curve	Start Station [m]	End Station [m]	Length [m]	Applied Cant (D) [mm]	Equili-brium Cant (D_{eq}) [mm]	Cant Defi-ciency (I) [mm]	Cant Gradi-ent	Vertical Speed [m/s]	Lateral Accele-ration [m/s^2]	Speed [km/h]
Curve.63										
Transition In Region	4282.07	4352.07	70.00							50
End Level Rail	4282.07			0.0	0.0	0.0			0.000	50
Begin Full Cant	4352.07			150.0	212.2	62.2	0.21%	0.030	0.407	50
Begin Curve	4328.73				212.2					50
Transition Out Region	4731.99	4801.99	70.00							50
End Full Cant	4731.99			150.0	212.2	62.2	0.00%	0.000	0.407	50
End Curve	4755.33				212.2					50
Begin Level Rail	4801.99			0.0	0.0	0.0	-0.21%	-0.030	0.000	50
Curve.64										
Transition In Region	5161.88	5181.88	20.00							50
End Level Rail	5161.88			0.0	0.0	0.0	0.00%	0.000	0.000	50
Begin Full Cant	5181.88			0.0	29.5	29.5	0.00%	0.000	0.193	50
Begin Curve	5181.88				29.5					50
Transition Out Region	5586.22	5606.22	20.00							50
End Full Cant	5586.22			0.0	29.5	29.5	0.00%	0.000	0.193	50
End Curve	5586.22				29.5					50
Begin Level Rail	5606.22			0.0	0.0	0.0	0.00%	0.000	0.000	50
Curve.65										
Transition In Region	5657.78	5702.78	45.00							50
End Level Rail	5657.78			0.0	0.0	0.0	0.00%	0.000	0.000	50
Begin Full Cant	5702.78			89.0	134.1	45.1	0.20%	0.027	0.295	50
Begin Curve	5702.78				134.1					50
Transition Out Region	5966.76	6011.76	45.00							50
End Full Cant	5966.76			89.0	134.1	45.1	0.00%	0.000	0.295	50
End Curve	5966.76				134.1					50
Begin Level Rail	6011.76			0.0	0.0	0.0	-0.20%	-0.027	0.000	50
Curve.66										
Transition In Region	6465.56	6485.56	20.00							50
End Level Rail	6465.56			0.0	0.0	0.0	0.00%	0.000	0.000	50
Begin Full Cant	6485.56			32.0	52.7	20.7	0.16%	0.022	0.135	50
Begin Curve	6485.56				52.7					50
Transition Out Region	6894.03	6914.03	20.00							50
End Full Cant	6894.03			32.0	52.7	20.7	0.00%	0.000	0.135	50
End Curve	6894.03				52.7					50
Begin Level Rail	6914.03			0.0	0.0	0.0	-0.16%	-0.022	0.000	50

Cant Curve	Start Station [m]	End Station [m]	Length [m]	Applied Cant (D) [mm]	Equili-brium Cant (D_{eq}) [mm]	Cant Defi-ciency (I) [mm]	Cant Gradi-ent	Vertical Speed [m/s]	Lateral Accele-ration [m/s^2]	Speed [km/h]
Curve.67										
Transition In Region	6974.98	6994.98	20.00							50
End Level Rail	6974.98			0.0	0.0	0.0	0.00%	0.000	0.000	50
Begin Full Cant	6994.98			22.0	36.9	14.9	0.11%	0.015	0.097	50
Begin Curve	6994.98				36.9					50
Transition Out Region	7261.49	7281.49	20.00							50
End Full Cant	7261.49			22.0	36.9	14.9	0.00%	0.000	0.097	50
End Curve	7261.49				36.9					50
Begin Level Rail	7281.49			0.0	0.0	0.0	-0.11%	-0.015	0.000	50
Curve.68										
Transition In Region	7349.57	7369.57	20.00							50
End Level Rail	7349.57			0.0	0.0	0.0	0.00%	0.000	0.000	50
Begin Full Cant	7369.57			30.0	49.2	19.2	0.15%	0.021	0.125	50
Begin Curve	7369.57				49.2					50
Transition Out Region	7509.21	7529.21	20.00							50
End Full Cant	7509.21			30.0	49.2	19.2	0.00%	0.000	0.125	50
End Curve	7509.21				49.2					50
Begin Level Rail	7529.21			0.0	0.0	0.0	-0.15%	-0.021	0.000	50
Curve.69										
Transition In Region	7582.42	7606.42	24.00							50
End Level Rail	7582.42			0.0	0.0	0.0	0.00%	0.000	0.000	50
Begin Full Cant	7606.42			51.0	77.6	26.6	0.21%	0.030	0.174	50
Begin Curve	7606.42				77.6					50
Transition Out Region	7913.86	7937.86	24.00							50
End Full Cant	7913.86			51.0	77.6	26.6	0.00%	0.000	0.174	50
End Curve	7937.86				77.6					50
Begin Level Rail	7937.86			0.0	0.0	0.0	-0.21%	-0.030	0.000	50
Curve.70										
Transition In Region	7954.56	7978.56	24.00							50
End Level Rail	7954.56			0.0	0.0	0.0			0.000	50
Begin Full Cant	7978.56			51.0	79.7	28.7	0.21%	0.030	0.188	50
Begin Curve	7954.56				79.7					50
Transition Out Region	8083.71	8107.71	24.00							50
End Full Cant	8083.71			51.0	79.7	28.7	0.00%	0.000	0.188	50
End Curve	8083.71				79.7					50
Begin Level Rail	8107.71			0.0	0.0	0.0	-0.21%	-0.030	0.000	50

Cant Curve	Start Station [m]	End Station [m]	Length [m]	Applied Cant (D) [mm]	Equilibrium Cant (D_{eq}) [mm]	Cant Deficiency (I) [mm]	Cant Gradient	Vertical Speed [m/s]	Lateral Acceleration [m/s^2]	Speed [km/h]
Curve.71										
Transition In Region	8136.18	8156.18	20.00							50
End Level Rail	8136.18			0.0	0.0	0.0	0.00%	0.000	0.000	50
Begin Full Cant	8156.18			36.0	59.0	23.0	0.18%	0.025	0.150	50
Begin Curve	8156.18				59.0					50
Transition Out Region	8247.31	8267.31	20.00							50
End Full Cant	8247.31			36.0	59.0	23.0	0.00%	0.000	0.150	50
End Curve	8247.31				59.0					50
Begin Level Rail	8267.31			0.0	0.0	0.0	-0.18%	-0.025	0.000	50
Curve.72										
Transition In Region	8275.39	8295.39	20.00							50
End Level Rail	8275.39			0.0	0.0	0.0	0.00%	0.000	0.000	50
Begin Full Cant	8295.39			36.0	59.0	23.0	0.18%	0.025	0.150	50
Begin Curve	8295.39				59.0					50
Transition Out Region	8687.49	8707.49	20.00							50
End Full Cant	8687.49			36.0	59.0	23.0	0.00%	0.000	0.150	50
End Curve	8687.49				59.0					50
Begin Level Rail	8707.49			0.0	0.0	0.0	-0.18%	-0.025	0.000	50
Curve.73										
Transition In Region	9104.27	9128.27	24.00							20
End Level Rail	9104.27			0.0	0.0	0.0	0.00%	0.000	0.000	20
Begin Full Cant	9128.27			48.0	78.7	30.7	0.20%	0.011	0.201	20
Begin Curve	9128.27				78.7					20
Transition Out Region	9263.11	9315.29	24.00							20
End Full Cant	9263.11			48.0	78.7	30.7	0.00%	0.000	0.201	20
End Curve	9287.11				78.7					20
Begin Level Rail	9287.11			0.0	0.0	0.0	-0.20%	-0.011	0.000	20
Curve.74										
Transition In Region	9305.86	9332.86	27.00							45
End Level Rail	9305.86			0.0	0.0	0.0	0.00%	0.000	0.000	45
Begin Full Cant	9332.86			53.0	86.9	33.9	0.20%	0.025	0.222	45
Begin Curve	9305.86				86.9					45
Transition Out Region	9785.38	9812.38	27.00							45
End Full Cant	9785.38			53.0	86.9	33.9	0.00%	0.000	0.222	45
End Curve	9785.38				86.9					45
Begin Level Rail	9812.38			0.0	0.0	0.0	-0.20%	-0.025	0.000	45

Cant Curve	Start Station [m]	End Station [m]	Length [m]	Applied Cant (D) [mm]	Equili-brium Cant (D_{eq}) [mm]	Cant Defi-ciency (I) [mm]	Cant Gradi-ent	Vertical Speed [m/s]	Lateral Accele-ration [m/s^2]	Speed [km/h]
Curve.75										
Transition In Region	10005.31	10027.31	22.00							50
End Level Rail	10005.31			0.0	0.0	0.0	0.00%	0.000	0.000	50
Begin Full Cant	10027.31			44.0	73.8	29.8	0.20%	0.028	0.194	50
Begin Curve	10027.31				73.8					50
Transition Out Region	10245.33	10267.33	22.00							50
End Full Cant	10245.33			44.0	73.8	29.8	0.00%	0.000	0.194	50
End Curve	10245.33				73.8					50
Begin Level Rail	10267.33			0.0	0.0	0.0	-0.20%	-0.028	0.000	50
Curve.76										
Transition In Region	10327.10	10349.10	22.00							50
End Level Rail	10327.10			0.0	0.0	0.0	0.00%	0.000	0.000	50
Begin Full Cant	10349.10			44.0	73.8	29.8	0.20%	0.028	0.194	50
Begin Curve	10349.10				73.8					50
Transition Out Region	10612.58	10634.58	22.00							50
End Full Cant	10612.58			44.0	73.8	29.8	0.00%	0.000	0.194	50
End Curve	10634.58				73.8					50
Begin Level Rail	10634.58			0.0	0.0	0.0	-0.20%	-0.028	0.000	50
Curve.77										
Transition In Region	10660.23	10696.23	36.00							50
End Level Rail	10660.23			0.0	0.0	0.0	0.00%	0.000	0.000	50
Begin Full Cant	10696.23			71.0	118.0	47.0	0.20%	0.027	0.307	50
Begin Curve	10684.23				118.0					50
Transition Out Region	10985.34	11021.34	36.00							50
End Full Cant	10985.34			71.0	118.0	47.0	0.00%	0.000	0.307	50
End Curve	10985.34				118.0					50
Begin Level Rail	11021.34			0.0	0.0	0.0	-0.20%	-0.027	0.000	50
Curve.78										
Transition In Region	11040.09	11060.09	20.00							50
End Level Rail	11040.09			0.0	0.0	0.0	0.00%	0.000	0.000	50
Begin Full Cant	11060.09			36.0	59.0	23.0	0.18%	0.025	0.150	50
Begin Curve	11060.09				59.0					50
Transition Out Region	11233.77	11253.77	20.00							50
End Full Cant	11233.77			36.0	59.0	23.0	0.00%	0.000	0.150	50
End Curve	11233.77				59.0					50
Begin Level Rail	11253.77			0.0	0.0	0.0	-0.18%	-0.025	0.000	50

Cant Curve	Start Station [m]	End Station [m]	Length [m]	Applied Cant (D) [mm]	Equili-brium Cant (D_{eq}) [mm]	Cant Defi-ciency (I) [mm]	Cant Gradi-ent	Vertical Speed [m/s]	Lateral Accele-ration [m/s^2]	Speed [km/h]
Curve.79										
Transition In Region	11481.01	11510.01	29.00							50
End Level Rail	11481.01			0.0	0.0	0.0	0.00%	0.000	0.000	50
Begin Full Cant	11510.01			59.0	89.4	30.4	0.20%	0.028	0.199	50
Begin Curve	11510.01				89.4					50
Transition Out Region	11876.57	11905.57	29.00							50
End Full Cant	11876.57			59.0	89.4	30.4	0.00%	0.000	0.199	50
End Curve	11876.57				89.4					50
Begin Level Rail	11905.57			0.0	0.0	0.0	-0.20%	-0.028	0.000	50
Curve.80										
Transition In Region	12185.77	12245.77	60.00							50
End Level Rail	12185.77			0.0	0.0	0.0	0.00%	0.000	0.000	50
Begin Full Cant	12245.77			118.0	155.3	37.3	0.20%	0.027	0.244	50
Begin Curve	12225.77				155.3					50
Transition Out Region	12416.82	12476.82	60.00							50
End Full Cant	12416.82			118.0	155.3	37.3	0.00%	0.000	0.244	50
End Curve	12436.82				155.3					50
Begin Level Rail	12476.82			0.0	0.0	0.0	-0.20%	-0.027	0.000	50
Curve.81										
Transition In Region	12505.34	12525.34	20.00							50
End Level Rail	12505.34			0.0	0.0	0.0	0.00%	0.000	0.000	50
Begin Full Cant	12525.34			36.0	59.0	23.0	0.18%	0.025	0.150	50
Begin Curve	12525.34				59.0					50
Transition Out Region	12586.97	12606.97	20.00							50
End Full Cant	12586.97			36.0	59.0	23.0	0.00%	0.000	0.150	50
End Curve	12586.97				59.0					50
Begin Level Rail	12606.97			0.0	0.0	0.0	-0.18%	-0.025	0.000	50
Curve.82										
Transition In Region	12655.11	12700.11	45.00							50
End Level Rail	12655.11			0.0	0.0	0.0	0.00%	0.000	0.000	50
Begin Full Cant	12700.11			89.0	140.5	51.5	0.20%	0.027	0.337	50
Begin Curve	12700.11				140.5					50
Transition Out Region	12953.31	12998.31	45.00							50
End Full Cant	12953.31			89.0	140.5	51.5	0.00%	0.000	0.337	50
End Curve	12968.31				140.5					50
Begin Level Rail	12998.31			0.0	0.0	0.0	-0.20%	-0.027	0.000	50

Cant Curve	Start Station [m]	End Station [m]	Length [m]	Applied Cant (D) [mm]	Equili-brium Cant (D_{eq}) [mm]	Cant Defi-ciency (I) [mm]	Cant Gradi-ent	Vertical Speed [m/s]	Lateral Accele-ration [m/s^2]	Speed [km/h]
Curve.83										
Transition In Region	13021.54	13081.54	60.00							50
End Level Rail	13021.54			0.0	0.0	0.0			0.000	50
Begin Full Cant	13081.54			118.0	155.3	37.3	0.20%	0.027	0.244	50
Begin Curve	13061.54				155.3					50
Transition Out Region	13231.61	13291.61	60.00							50
End Full Cant	13231.61			118.0	155.3	37.3	0.00%	0.000	0.244	50
End Curve	13251.61				155.3					50
Begin Level Rail	13291.61			0.0	0.0	0.0	-0.20%	-0.027	0.000	50
Curve.84										
Transition In Region	13318.47	13378.47	60.00							50
End Level Rail	13318.47			0.0	0.0	0.0			0.000	50
Begin Full Cant	13378.47			118.0	155.3	37.3	0.20%	0.027	0.244	50
Begin Curve	13358.47				155.3					50
Transition Out Region	13491.86	13571.86	60.00							50
End Full Cant	13491.86			118.0	155.3	37.3	0.00%	0.000	0.244	50
End Curve	13511.86				155.3					50
Begin Level Rail	13551.86			0.0	0.0	0.0	-0.20%	-0.027	0.000	50
Curve.85										
Transition In Region	13636.79	13696.79	60.00							50
End Level Rail	13636.79			0.0	0.0	0.0	0.00%	0.000	0.000	50
Begin Full Cant	13696.79			118.0	155.3	37.3	0.20%	0.027	0.244	50
Begin Curve	13676.79				155.3					50
Transition Out Region	13864.67	13924.67	60.00							50
End Full Cant	13864.67			118.0	155.3	37.3	0.00%	0.000	0.244	50
End Curve	13884.67				155.3					50
Begin Level Rail	13924.67			0.0	0.0	0.0	-0.20%	-0.027	0.000	50
Curve.86										
Transition In Region	13963.75	14008.75	45.00							50
End Level Rail	13963.75			0.0	0.0	0.0	0.00%	0.000	0.000	50
Begin Full Cant	14008.75			89.0	140.5	51.5	0.20%	0.027	0.337	50
Begin Curve	14008.75				140.5					50
Transition Out Region	14387.32	14432.32	45.00							50
End Full Cant	14387.32			89.0	140.5	51.5	0.00%	0.000	0.337	50
End Curve	14387.32				140.5					50
Begin Level Rail	14432.32			0.0	0.0	0.0	-0.20%	-0.027	0.000	50

Cant Curve	Start Station [m]	End Station [m]	Length [m]	Applied Cant (D) [mm]	Equilibrium Cant (D_{eq}) [mm]	Cant Deficiency (I) [mm]	Cant Gradient	Vertical Speed [m/s]	Lateral Acceleration [m/s^2]	Speed [km/h]
Curve.87										
Transition In Region	14508.97	14599.97	91.00							80
End Level Rail	14508.97			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	14599.97			114.0	175.6	61.6	0.13%	0.028	0.403	80
Begin Curve	14579.63				175.6					80
Transition Out Region	14932.10	15023.10	91.00							80
End Full Cant	14932.10			114.0	175.6	61.6	0.00%	0.000	0.403	80
End Curve	14962.44				175.6					80
Begin Level Rail	15023.10			0.0	0.0	0.0	- 0.13%	-0.028	0.000	80
Curve.88										
Transition In Region	15160.46	15276.46	116.00							70
End Level Rail	15160.46			0.0	0.0	0.0	0.00%	0.000	0.000	70
Begin Full Cant	15276.46			145.0	241.0	96.0	0.13%	0.024	0.628	70
Begin Curve	15237.79				241.0					70
Transition Out Region	15393.14	15509.14	116.00							70
End Full Cant	15393.14			145.0	241.0	96.0	0.00%	0.000	0.628	70
End Curve	15431.81				241.0					70
Begin Level Rail	15509.14			0.0	0.0	0.0	- 0.13%	-0.024	0.000	70
Curve.89										
Transition In Region	16125.82	16198.82	73.00							80
End Level Rail	16125.82			0.0	0.0	0.0	0.00%	0.000	0.000	80
Begin Full Cant	16198.82			91.0	142.5	51.5	0.12%	0.028	0.337	80
Begin Curve	16198.82				142.5					80
Transition Out Region	16678.28	16751.28	73.00							80
End Full Cant	16678.28			91.0	142.5	51.5	0.00%	0.000	0.337	80
End Curve	16678.28				142.5					80
Begin Level Rail	16751.28			0.0	0.0	0.0	- 0.12%	-0.028	0.000	80
Curve.90										
Transition In Region	17636.24	17696.24	60.00							50
End Level Rail	17636.24			0.0	0.0	0.0	0.00%	0.000	0.000	50
Begin Full Cant	17696.24			118.0	155.3	37.3	0.20%	0.027	0.244	50
Begin Curve	17676.24				155.3					50
Transition Out Region	17945.03	18005.03	60.00							50
End Full Cant	17945.03			118.0	155.3	37.3	0.00%	0.000	0.244	50
End Curve	17965.03				155.3					50
Begin Level Rail	18005.03			0.0	0.0	0.0	- 0.20%	-0.027	0.000	50

Cant Curve	Start Station [m]	End Station [m]	Length [m]	Applied Cant (D) [mm]	Equili-brium Cant (D_{eq}) [mm]	Cant Defi-ciency (I) [mm]	Cant Gradi-ent	Vertical Speed [m/s]	Lateral Accele-ration [m/s^2]	Speed [km/h]
Curve.91										
Transition In Region	18122.21	18170.21	48.00							45
End Level Rail	18122.21			0.0	0.0	0.0	0.00%	0.000	0.000	45
Begin Full Cant	18170.21			96.0	159.3	63.3	0.20%	0.025	0.414	45
Begin Curve	18170.21				159.3					45
Transition Out Region	18350.17	18398.17	48.00							45
End Full Cant	18350.17			96.0	159.3	63.3	0.00%	0.000	0.414	45
End Curve	18398.17				159.3					45
Begin Level Rail	18398.17			0.0	0.0	0.0	-0.20%	-0.025	0.000	45
Curve.92										
Transition In Region	18424.76	18444.76	20.00							50
End Level Rail	18424.76			0.0	0.0	0.0	0.00%	0.000	0.000	50
Begin Full Cant	18444.76			25.0	42.1	17.1	-0.20%	-0.027	0.112	50
Begin Curve	18424.76				42.1					50
Transition Out Region	18872.17	18892.17	20.00							50
End Full Cant	18872.17			25.0	42.1	17.1	0.01%	0.001	0.112	50
End Curve	18872.17				42.1					50
Begin Level Rail	18892.17			0.0	0.0	0.0	-0.12%	-0.017	0.000	50
Curve.93										
Transition In Region	19092.18	19128.18	36.00							50
End Level Rail	19092.18			0.0	0.0	0.0	0.00%	0.000	0.000	50
Begin Full Cant	19128.18			71.0	118.0	47.0	0.20%	0.027	0.307	50
Begin Curve	19128.18				118.0					50
Transition Out Region	19325.66	19361.66	36.00							50
End Full Cant	19325.66			71.0	118.0	47.0	0.00%	0.000	0.307	50
End Curve	19325.66				118.0					50
Begin Level Rail	19361.66			0.0	0.0	0.0	-0.20%	-0.027	0.000	50
Curve.94										
Transition In Region	19499.30	19519.30	20.00							50
End Level Rail	19499.30			0.0	0.0	0.0	0.00%	0.000	0.000	50
Begin Full Cant	19519.30			36.0	59.0	23.0	0.18%	0.025	0.150	50
Begin Curve	19519.30				59.0					50
Transition Out Region	19740.94	19760.94	20.00							50
End Full Cant	19740.94			36.0	59.0	23.0	0.00%	0.000	0.150	50
End Curve	19740.94				59.0					50
Begin Level Rail	19760.94			0.0	0.0	0.0	-0.18%	-0.025	0.000	50

Cant Curve	Start Station [m]	End Station [m]	Length [m]	Applied Cant (D) [mm]	Equili-brium Cant (D_{eq}) [mm]	Cant Defi-ciency (I) [mm]	Cant Gradi-ent	Vertical Speed [m/s]	Lateral Accele-ration [m/s^2]	Speed [km/h]
Curve.95										
Transition In Region	20068.55	20097.55	29.00							50
End Level Rail	20068.55			0.0	0.0	0.0	0.00%	0.000	0.000	50
Begin Full Cant	20097.55			59.0	98.3	39.3	0.20%	0.028	0.257	50
Begin Curve	20097.55				98.3					50
Transition Out Region	20362.74	20391.74	29.00							50
End Full Cant	20362.74			59.0	98.3	39.3	0.00%	0.000	0.257	50
End Curve	20362.74				98.3					50
Begin Level Rail	20391.74			0.0	0.0	0.0	-0.20%	-0.028	0.000	50
Curve.96										
Transition In Region	20478.61	20498.61	20.00							50
End Level Rail	20478.61			0.0	0.0	0.0	0.00%	0.000	0.000	50
Begin Full Cant	20498.61			36.0	59.0	23.0	0.18%	0.025	0.150	50
Begin Curve	20498.61				59.0					50
Transition Out Region	20710.94	20730.94	20.00							50
End Full Cant	20710.94			36.0	59.0	23.0	0.00%	0.000	0.150	50
End Curve	20710.94				59.0					50
Begin Level Rail	20730.94			0.0	0.0	0.0	-0.18%	-0.025	0.000	50
Curve.97										
Transition In Region	20836.43	20858.43	22.00							50
End Level Rail	20836.43			0.0	0.0	0.0	0.00%	0.000	0.000	50
Begin Full Cant	20858.43			44.0	73.8	29.8	0.20%	0.028	0.194	50
Begin Curve	20858.43				73.8					50
Transition Out Region	21205.00	21227.00	22.00							50
End Full Cant	21205.00			44.0	73.8	29.8	0.00%	0.000	0.194	50
End Curve	21205.00				73.8					50
Begin Level Rail	21227.00			0.0	0.0	0.0	-0.20%	-0.028	0.000	50

APPENDIX B – LIST OF ALIGNMENT ELEMENTS

Line Ostrava – Rychvald – Orlová – Český Těšín (– Třinec)

No.	Type	Length	Radius	Direction	Start Station	End Station	Delta angle	Chord length
1	Line	34.89m		N53.097037E (d)	0.00m	34.89m		
2	Curve	309.50m	200.00m		34.89m	344.39m	088.6643 (d)	279.53m
3	Line	169.42m		S38.238699E (d)	344.39m	513.81m		
4	Curve	175.13m	250.00m		513.81m	688.94m	040.1372 (d)	171.57m
5	Line	213.63m		S78.375852E (d)	688.94m	902.57m		
6	Curve	85.45m	350.00m		902.57m	988.02m	013.9888 (d)	85.24m
7	Line	89.19m		N87.635333E (d)	988.02m	1077.21m		
8	Curve	41.44m	500.00m		1077.21m	1118.66m	004.7489 (d)	41.43m
9	Line	1022.79m		S87.615784E (d)	1118.66m	2141.45m		
10	Curve	245.02m	320.00m		2141.45m	2386.47m	043.8701 (d)	239.08m
11	Line	23.24m		N48.514105E (d)	2386.47m	2409.70m		
12	Curve	176.98m	300.00m		2409.70m	2586.68m	033.8003 (d)	174.42m
13	Line	319.05m		N82.314436E (d)	2586.68m	2905.73m		
14	Curve	111.16m	500.00m		2905.73m	3016.89m	012.7380 (d)	110.93m
15	Line	288.25m		S84.947573E (d)	3016.89m	3305.13m		
16	Curve	321.40m	330.00m		3305.13m	3626.53m	055.8022 (d)	308.85m
17	Line	15.38m		N39.250188E (d)	3626.53m	3641.92m		
18	Curve	90.67m	220.00m		3641.92m	3732.58m	023.6128 (d)	90.03m
19	Line	47.20m		N62.862945E (d)	3732.58m	3779.78m		
20	Curve	277.18m	200.00m		3779.78m	4056.96m	079.4061 (d)	255.52m
21	Line	90.34m		S37.730986E (d)	4056.96m	4147.30m		
22	Curve	448.41m	750.00m		4147.30m	4595.71m	034.2562 (d)	441.76m
23	Line	752.14m		S71.987182E (d)	4595.71m	5347.85m		
24	Curve	365.34m	2000.00m		5347.85m	5713.19m	010.4661 (d)	364.83m
25	Line	1061.43m		S82.453299E (d)	5713.19m	6774.62m		
26	Curve	487.68m	950.00m		6774.62m	7262.29m	029.4124 (d)	482.34m

No.	Type	Length	Radius	Direction	Start Station	End Station	Delta angle	Chord length
27	Line	905.25m		S53.040880E (d)	7262.29m	8167.55m		
28	Curve	399.36m	1200.00m		8167.55m	8566.90m	019.0679 (d)	397.52m
29	Line	558.83m		S72.108817E (d)	8566.90m	9125.74m		
30	Curve	699.69m	960.00m		9125.74m	9825.43m	041.7599 (d)	684.31m
31	Line	1156.75m		S30.348948E (d)	9825.43m	10982.18m		
32	Curve	743.28m	650.00m		10982.18m	11725.45m	065.5180 (d)	703.44m
33	Line	579.75m		N84.133089E (d)	11725.45m	12305.20m		
34	Curve	460.46m	1300.00m		12305.20m	12765.66m	020.2941 (d)	458.05m
35	Line	25.92m		N63.839009E (d)	12765.66m	12791.58m		
36	Curve	132.82m	800.00m		12791.58m	12924.40m	009.5127 (d)	132.67m
37	Line	102.57m		N73.351699E (d)	12924.40m	13026.97m		
38	Curve	169.46m	1000.00m		13026.97m	13196.43m	009.7091 (d)	169.25m
39	Line	80.70m		N63.642607E (d)	13196.43m	13277.12m		
40	Curve	123.73m	1000.00m		13277.12m	13400.85m	007.0892 (d)	123.65m
41	Line	174.58m		N70.731807E (d)	13400.85m	13575.43m		
42	Curve	259.27m	460.00m		13575.43m	13834.70m	032.2937 (d)	255.85m
43	Line	585.07m		S76.974521E (d)	13834.70m	14419.77m		
44	Curve	242.31m	1050.00m		14419.77m	14662.07m	013.2220 (d)	241.77m
45	Line	432.31m		N89.803496E (d)	14662.07m	15094.38m		
46	Curve	647.29m	1450.00m		15094.38m	15741.67m	025.5771 (d)	641.92m
47	Line	300.01m		S64.619427E (d)	15741.67m	16041.68m		
48	Curve	190.46m	1000.00m		16041.68m	16232.14m	010.9125 (d)	190.17m
49	Line	3961.70m		S53.706915E (d)	16232.14m	20193.84m		
50	Curve	253.34m	850.00m		20193.84m	20447.18m	017.0769 (d)	252.40m
51	Line	2218.07m		S36.629969E (d)	20447.18m	22665.25m		

No.	Chord Direction	Start Direction	End Direction	Mid-Ordinate	External Tangent	External Secant	PI Included Angle
1							
2	S82.570831E (d)	N53.097037E (d)	S38.238699E (d)	56.94	195.39m	79.60m	091.3357 (d)
3							
4	S58.307275E (d)	S38.238699E (d)	S78.375852E (d)	15.18	91.33m	16.16m	139.8628 (d)
5							
6	S85.370259E (d)	S78.375852E (d)	N87.635333E (d)	2.6	42.94m	2.62m	166.0112 (d)
7							
8	S89.990226E (d)	N87.635333E (d)	S87.615784E (d)	0.43	20.73m	0.43m	175.2511 (d)
9							
10	N70.449160E (d)	S87.615784E (d)	N48.514105E (d)	23.17	128.87m	24.97m	136.1299 (d)
11							
12	N65.414270E (d)	N48.514105E (d)	N82.314436E (d)	12.96	91.15m	13.54m	146.1997 (d)
13							
14	N88.683431E (d)	N82.314436E (d)	S84.947573E (d)	3.09	55.81m	3.11m	167.2620 (d)
15							
16	N67.151307E (d)	S84.947573E (d)	N39.250188E (d)	38.36	174.73m	43.41m	124.1978 (d)
17							
18	N51.056566E (d)	N39.250188E (d)	N62.862945E (d)	4.65	45.99m	4.75m	156.3872 (d)
19							
20	S77.434021E (d)	N62.862945E (d)	S37.730986E (d)	46.13	166.06m	59.95m	100.5939 (d)
21							
22	S54.859084E (d)	S37.730986E (d)	S71.987182E (d)	33.26	231.13m	34.81m	145.7438 (d)
23							
24	S77.220241E (d)	S71.987182E (d)	S82.453299E (d)	8.34	183.18m	8.37m	169.5339 (d)
25							
26	S67.747090E (d)	S82.453299E (d)	S53.040880E (d)	31.12	249.34m	32.18m	150.5876 (d)

No.	Chord Direction	Start Direction	End Direction	Mid-Ordinate	External Tangent	External Secant	PI Included Angle
27							
28	S62.574849E (d)	S53.040880E (d)	S72.108817E (d)	16.57	201.54m	16.81m	160.9321 (d)
29							
30	S51.228883E (d)	S72.108817E (d)	S30.348948E (d)	63.04	366.20m	67.47m	138.2401 (d)
31							
32	S63.107930E (d)	S30.348948E (d)	N84.133089E (d)	103.38	418.24m	122.93m	114.4820 (d)
33							
34	N73.986049E (d)	N84.133089E (d)	N63.839009E (d)	20.33	232.67m	20.66m	159.7059 (d)
35							
36	N68.595354E (d)	N63.839009E (d)	N73.351699E (d)	2.75	66.56m	2.76m	170.4873 (d)
37							
38	N68.497153E (d)	N73.351699E (d)	N63.642607E (d)	3.59	84.93m	3.60m	170.2909 (d)
39							
40	N67.187207E (d)	N63.642607E (d)	N70.731807E (d)	1.91	61.94m	1.92m	172.9108 (d)
41							
42	N86.878643E (d)	N70.731807E (d)	S76.974521E (d)	18.15	133.18m	18.89m	147.7063 (d)
43							
44	S83.585513E (d)	S76.974521E (d)	N89.803496E (d)	6.98	121.69m	7.03m	166.7780 (d)
45							
46	S77.407965E (d)	N89.803496E (d)	S64.619427E (d)	35.97	329.13m	36.88m	154.4229 (d)
47							
48	S59.163171E (d)	S64.619427E (d)	S53.706915E (d)	4.53	95.52m	4.55m	169.0875 (d)
49							
50	S45.168442E (d)	S53.706915E (d)	S36.629969E (d)	9.42	127.62m	9.53m	162.9231 (d)
51							

Line Ostrava – Petřvald – Orlová – Karviná

No.	Type	Length	Radius	Direction	Start Station	End Station	Delta angle	Chord length
1	Line	29.27m		S06.234631W (d)	0.00m	29.27m		
2	Curve	443.60m	310.00m		29.27m	472.87m	081.9885 (d)	406.71m
3	Line	446.11m		S75.753874E (d)	472.87m	918.99m		
4	Curve	31.70m	500.00m		918.99m	950.69m	003.6327 (d)	31.70m
5	Line	222.82m		S79.386582E (d)	950.69m	1173.51m		
6	Curve	19.80m	500.00m		1173.51m	1193.31m	002.2684 (d)	19.79m
7	Line	858.12m		S77.118212E (d)	1193.31m	2051.43m		
8	Curve	183.39m	800.00m		2051.43m	2234.81m	013.1341 (d)	182.99m
9	Line	88.85m		N89.747710E (d)	2234.81m	2323.66m		
10	Curve	147.36m	900.00m		2323.66m	2471.02m	009.3812 (d)	147.20m
11	Line	508.11m		S80.871041E (d)	2471.02m	2979.13m		
12	Curve	541.74m	370.00m		2979.13m	3520.87m	083.8897 (d)	494.63m
13	Line	250.77m		N15.239288E (d)	3520.87m	3771.64m		
14	Curve	230.05m	370.00m		3771.64m	4001.69m	035.6240 (d)	226.36m
15	Line	113.52m		N20.384675W (d)	4001.69m	4115.21m		
16	Curve	325.63m	700.00m		4115.21m	4440.84m	026.6533 (d)	322.70m
17	Line	328.87m		N06.268650E (d)	4440.84m	4769.71m		
18	Curve	97.22m	300.00m		4769.71m	4866.93m	018.5675 (d)	96.79m
19	Line	321.20m		N24.836199E (d)	4866.93m	5188.13m		
20	Curve	233.40m	2000.00m		5188.13m	5421.53m	006.6863 (d)	233.26m
21	Line	342.02m		N31.522538E (d)	5421.53m	5763.55m		
22	Curve	727.09m	380.00m		5763.55m	6490.64m	109.6289 (d)	621.14m
23	Line	772.02m		S38.848547E (d)	6490.64m	7262.66m		
24	Curve	232.41m	470.00m		7262.66m	7495.07m	028.3325 (d)	230.05m
25	Line	124.59m		S67.181095E (d)	7495.07m	7619.66m		
26	Curve	231.71m	600.00m		7619.66m	7851.38m	022.1271 (d)	230.28m
27	Line	175.33m		S45.054018E (d)	7851.38m	8026.71m		
28	Curve	271.12m	380.00m		8026.71m	8297.83m	040.8792 (d)	265.41m
29	Line	263.75m		S85.933181E (d)	8297.83m	8561.58m		
30	Curve	132.26m	680.00m		8561.58m	8693.84m	011.1440 (d)	132.05m
31	Line	100.33m		N82.922865E (d)	8693.84m	8794.16m		
32	Curve	189.09m	500.00m		8794.16m	8983.25m	021.6678 (d)	187.96m
33	Line	116.87m		S75.409332E (d)	8983.25m	9100.12m		

No.	Type	Length	Radius	Direction	Start Station	End Station	Delta angle	Chord length
34	Curve	248.53m	430.00m		9100.12m	9348.66m	033.1158 (d)	245.09m
35	Line	37.19m		N71.474904E (d)	9348.66m	9385.85m		
36	Curve	166.81m	430.00m		9385.85m	9552.66m	022.2273 (d)	165.77m
37	Line	265.70m		S86.297779E (d)	9552.66m	9818.36m		
38	Curve	168.37m	600.00m		9818.36m	9986.73m	016.0779 (d)	167.82m
39	Line	202.22m		S70.219861E (d)	9986.73m	10188.95m		
40	Curve	382.81m	430.00m		10188.95m	10571.76m	051.0076 (d)	370.29m
41	Line	275.35m		N58.772529E (d)	10571.76m	10847.11m		
42	Curve	194.02m	240.00m		10847.11m	11041.13m	046.3190 (d)	188.78m
43	Line	767.01m		S74.908480E (d)	11041.13m	11808.15m		
44	Curve	479.45m	530.00m		11808.15m	12287.60m	051.8312 (d)	463.27m
45	Line	596.62m		N53.260311E (d)	12287.60m	12884.22m		
46	Curve	535.64m	390.00m		12884.22m	13419.86m	078.6917 (d)	494.52m
47	Line	389.00m		S48.047967E (d)	13419.86m	13808.86m		
48	Curve	667.00m	800.00m		13808.86m	14475.86m	047.7704 (d)	647.85m
49	Line	572.53m		N84.181591E (d)	14475.86m	15048.39m		
50	Curve	461.56m	1300.00m		15048.39m	15509.95m	020.3426 (d)	459.14m
51	Line	25.35m		N63.839009E (d)	15509.95m	15535.30m		
52	Curve	132.82m	800.00m		15535.30m	15668.13m	009.5127 (d)	132.67m
53	Line	102.57m		N73.351699E (d)	15668.13m	15770.69m		
54	Curve	169.46m	1000.00m		15770.69m	15940.15m	009.7091 (d)	169.25m
55	Line	80.70m		N63.642607E (d)	15940.15m	16020.85m		
56	Curve	123.73m	1000.00m		16020.85m	16144.58m	007.0892 (d)	123.65m
57	Line	174.58m		N70.731807E (d)	16144.58m	16319.15m		
58	Curve	259.27m	460.00m		16319.15m	16578.42m	032.2937 (d)	255.85m
59	Line	585.07m		S76.974521E (d)	16578.42m	17163.49m		
60	Curve	242.31m	1050.00m		17163.49m	17405.80m	013.2220 (d)	241.77m
61	Line	432.31m		N89.803496E (d)	17405.80m	17838.10m		
62	Curve	647.29m	1450.00m		17838.10m	18485.39m	025.5771 (d)	641.92m
63	Line	300.00m		S64.619427E (d)	18485.39m	18785.39m		
64	Curve	190.48m	1000.00m		18785.39m	18975.87m	010.9137 (d)	190.19m
65	Line	3073.48m		S53.705738E (d)	18975.87m	22049.36m		
66	Curve	699.81m	280.00m		22049.36m	22749.16m	143.2004 (d)	531.37m
67	Line	4011.49m		N16.906148W (d)	22749.16m	26760.65m		

No.	Chord Direction	Start Direction	End Direction	Mid-Ordinate	External Tangent	External Secant	PI Included Angle
1							
2	S34.759621E (d)	S06.234631W (d)	S75.753874E (d)	76.02	269.42m	100.72m	098.0115 (d)
3							
4	S77.570228E (d)	S75.753874E (d)	S79.386582E (d)	0.25	15.86m	0.25m	176.3673 (d)
5							
6	S78.252397E (d)	S79.386582E (d)	S77.118212E (d)	0.1	9.90m	0.10m	177.7316 (d)
7							
8	S83.685251E (d)	S77.118212E (d)	N89.747710E (d)	5.25	92.10m	5.28m	166.8659 (d)
9							
10	S85.561665E (d)	N89.747710E (d)	S80.871041E (d)	3.01	73.85m	3.02m	170.6188 (d)
11							
12	N57.184124E (d)	S80.871041E (d)	N15.239288E (d)	94.8	332.51m	127.45m	096.1103 (d)
13							
14	N02.572693W (d)	N15.239288E (d)	N20.384675W (d)	17.74	118.88m	18.63m	144.3760 (d)
15							
16	N07.058013W (d)	N20.384675W (d)	N06.268650E (d)	18.85	165.82m	19.37m	153.3467 (d)
17							
18	N15.552425E (d)	N06.268650E (d)	N24.836199E (d)	3.93	49.04m	3.98m	161.4325 (d)
19							
20	N28.179369E (d)	N24.836199E (d)	N31.522538E (d)	3.4	116.83m	3.41m	173.3137 (d)
21							
22	N86.336996E (d)	N31.522538E (d)	S38.848547E (d)	161.03	538.97m	279.46m	070.3711 (d)
23							
24	S53.014821E (d)	S38.848547E (d)	S67.181095E (d)	14.29	118.63m	14.74m	151.6675 (d)
25							
26	S56.117557E (d)	S67.181095E (d)	S45.054018E (d)	11.15	117.32m	11.36m	157.8729 (d)
27							
28	S65.493600E (d)	S45.054018E (d)	S85.933181E (d)	23.92	141.62m	25.53m	139.1208 (d)
29							
30	N88.494842E (d)	S85.933181E (d)	N82.922865E (d)	3.21	66.34m	3.23m	168.8560 (d)
31							
32	S86.243234E (d)	N82.922865E (d)	S75.409332E (d)	8.91	95.69m	9.07m	158.3322 (d)
33							

No.	Chord Direction	Start Direction	End Direction	Mid-Ordinate	External Tangent	External Secant	PI Included Angle
34	N88.032786E (d)	S75.409332E (d)	N71.474904E (d)	17.83	127.84m	18.60m	146.8842 (d)
35							
36	N82.588563E (d)	N71.474904E (d)	S86.297779E (d)	8.06	84.47m	8.22m	157.7727 (d)
37							
38	S78.258820E (d)	S86.297779E (d)	S70.219861E (d)	5.9	84.74m	5.95m	163.9221 (d)
39							
40	N84.276334E (d)	S70.219861E (d)	N58.772529E (d)	41.9	205.13m	46.42m	128.9924 (d)
41							
42	N81.932024E (d)	N58.772529E (d)	S74.908480E (d)	19.34	102.66m	21.04m	133.6810 (d)
43							
44	N79.175915E (d)	S74.908480E (d)	N53.260311E (d)	53.3	257.53m	59.26m	128.1688 (d)
45							
46	S87.393828E (d)	N53.260311E (d)	S48.047967E (d)	88.4	319.73m	114.31m	101.3083 (d)
47							
48	S71.933188E (d)	S48.047967E (d)	N84.181591E (d)	68.51	354.26m	74.93m	132.2296 (d)
49							
50	N74.010300E (d)	N84.181591E (d)	N63.839009E (d)	20.43	233.23m	20.76m	159.6574 (d)
51							
52	N68.595354E (d)	N63.839009E (d)	N73.351699E (d)	2.75	66.56m	2.76m	170.4873 (d)
53							
54	N68.497153E (d)	N73.351699E (d)	N63.642607E (d)	3.59	84.93m	3.60m	170.2909 (d)
55							
56	N67.187207E (d)	N63.642607E (d)	N70.731807E (d)	1.91	61.94m	1.92m	172.9108 (d)
57							
58	N86.878643E (d)	N70.731807E (d)	S76.974521E (d)	18.15	133.18m	18.89m	147.7063 (d)
59							
60	S83.585513E (d)	S76.974521E (d)	N89.803496E (d)	6.98	121.69m	7.03m	166.7780 (d)
61							
62	S77.407965E (d)	N89.803496E (d)	S64.619427E (d)	35.97	329.13m	36.88m	154.4229 (d)
63							
64	S59.162582E (d)	S64.619427E (d)	S53.705738E (d)	4.53	95.53m	4.55m	169.0863 (d)
65							
66	N54.694057E (d)	S53.705738E (d)	N16.906148W (d)	191.62	841.72m	607.07m	036.7996 (d)
67							

Line Havířov – Petřvald – Orlová

No.	Type	Length	Radius	Direction	Start Station	End Station	Delta angle	Chord length
1	Line	124.94m		N62.938420W (d)	0.00m	124.94m		
2	Curve	135.89m	1500.00m		124.94m	260.83m	005.1907 (d)	135.85m
3	Line	2004.07m		N68.129123W (d)	260.83m	2264.90m		
4	Curve	158.45m	1000.00m		2264.90m	2423.35m	009.0782 (d)	158.28m
5	Line	137.52m		N59.050882W (d)	2423.35m	2560.87m		
6	Curve	136.83m	600.00m		2560.87m	2697.70m	013.0662 (d)	136.53m
7	Line	1087.88m		N45.984647W (d)	2697.70m	3785.58m		
8	Curve	449.23m	200.00m		3785.58m	4234.81m	128.6936 (d)	360.57m
9	Line	93.92m		N82.708998E (d)	4234.81m	4328.73m		
10	Curve	426.60m	139.00m		4328.73m	4755.33m	175.8425 (d)	277.82m
11	Line	426.56m		S86.866484W (d)	4755.33m	5181.88m		
12	Curve	404.33m	1000.00m		5181.88m	5586.22m	023.1667 (d)	401.59m
13	Line	116.57m		S63.699799W (d)	5586.22m	5702.78m		
14	Curve	263.98m	220.00m		5702.78m	5966.76m	068.7492 (d)	248.42m
15	Line	518.80m		N47.551042W (d)	5966.76m	6485.56m		
16	Curve	408.47m	560.00m		6485.56m	6894.03m	041.7924 (d)	399.48m
17	Line	100.94m		N05.758602W (d)	6894.03m	6994.98m		
18	Curve	266.51m	800.00m		6994.98m	7261.49m	019.0874 (d)	265.28m
19	Line	108.08m		N24.845967W (d)	7261.49m	7369.57m		
20	Curve	139.64m	600.00m		7369.57m	7509.21m	013.3348 (d)	139.33m
21	Line	97.22m		N11.511195W (d)	7509.21m	7606.42m		
22	Curve	331.43m	380.00m		7606.42m	7937.86m	049.9728 (d)	321.03m
23	Line	16.70m		N61.483961W (d)	7937.86m	7954.56m		
24	Curve	129.15m	370.00m		7954.56m	8083.71m	019.9998 (d)	128.50m
25	Line	72.47m		N41.484176W (d)	8083.71m	8156.18m		
26	Curve	91.13m	500.00m		8156.18m	8247.31m	010.4432 (d)	91.01m
27	Line	48.08m		N51.927349W (d)	8247.31m	8295.39m		
28	Curve	392.09m	500.00m		8295.39m	8687.49m	044.9307 (d)	382.12m
29	Line	440.78m		N06.996671W (d)	8687.49m	9128.27m		
30	Curve	158.84m	60.00m		9128.27m	9287.11m	151.6828 (d)	116.35m

No.	Type	Length	Radius	Direction	Start Station	End Station	Delta angle	Chord length
31	Line	18.75m		S21.320567W (d)	9287.11m	9305.86m		
32	Curve	479.53m	275.00m		9305.86m	9785.38m	099.9083 (d)	421.04m
33	Line	241.92m		N58.771155W (d)	9785.38m	10027.31m		
34	Curve	218.02m	400.00m		10027.31m	10245.33m	031.2288 (d)	215.33m
35	Line	103.78m		N90.000000W (d)	10245.33m	10349.10m		
36	Curve	285.48m	400.00m		10349.10m	10634.58m	040.8916 (d)	279.46m
37	Line	49.65m		N49.108448W (d)	10634.58m	10684.23m		
38	Curve	301.11m	250.00m		10684.23m	10985.34m	069.0103 (d)	283.24m
39	Line	74.75m		N19.901894E (d)	10985.34m	11060.09m		
40	Curve	173.68m	500.00m		11060.09m	11233.77m	019.9019 (d)	172.80m
41	Line	276.24m		N00.000000E (d)	11233.77m	11510.01m		
42	Curve	366.57m	330.00m		11510.01m	11876.57m	063.6444 (d)	348.01m
43	Line	349.20m		N63.644408E (d)	11876.57m	12225.77m		
44	Curve	211.05m	190.00m		12225.77m	12436.82m	063.6444 (d)	200.37m
45	Line	88.51m		N00.000000E (d)	12436.82m	12525.34m		
46	Curve	61.63m	500.00m		12525.34m	12586.97m	007.0626 (d)	61.59m
47	Line	113.14m		N07.062559E (d)	12586.97m	12700.11m		
48	Curve	268.20m	210.00m		12700.11m	12968.31m	073.1741 (d)	250.34m
49	Line	93.23m		N80.236698E (d)	12968.31m	13061.54m		
50	Curve	190.06m	190.00m		13061.54m	13251.61m	057.3149 (d)	182.24m
51	Line	106.86m		N22.921748E (d)	13251.61m	13358.47m		
52	Curve	153.40m	190.00m		13358.47m	13511.86m	046.2575 (d)	149.26m
53	Line	164.93m		N69.179277E (d)	13511.86m	13676.79m		
54	Curve	207.88m	190.00m		13676.79m	13884.67m	062.6869 (d)	197.66m
55	Line	124.08m		N06.492360E (d)	13884.67m	14008.75m		
56	Curve	378.57m	210.00m		14008.75m	14387.32m	103.2878 (d)	329.35m
57	Line	192.31m		S70.219861E (d)	14387.32m	14579.63m		
58	Curve	382.81m	430.00m		14579.63m	14962.44m	051.0076 (d)	370.29m
59	Line	275.35m		N58.772529E (d)	14962.44m	15237.79m		
60	Curve	194.02m	240.00m		15237.79m	15431.81m	046.3190 (d)	188.78m

No.	Type	Length	Radius	Direction	Start Station	End Station	Delta angle	Chord length
61	Line	767.01m		S74.908480E (d)	15431.81m	16198.82m		
62	Curve	479.45m	530.00m		16198.82m	16678.28m	051.8312 (d)	463.27m
63	Line	997.96m		N53.260311E (d)	16678.28m	17676.24m		
64	Curve	288.79m	190.00m		17676.24m	17965.03m	087.0860 (d)	261.78m
65	Line	205.18m		N33.825697W (d)	17965.03m	18170.21m		
66	Curve	227.97m	150.00m		18170.21m	18398.17m	087.0766 (d)	206.65m
67	Line	26.58m		N53.250911E (d)	18398.17m	18424.76m		
68	Curve	447.41m	700.00m		18424.76m	18872.17m	036.6210 (d)	439.83m
69	Line	256.02m		N16.629907E (d)	18872.17m	19128.18m		
70	Curve	197.48m	250.00m		19128.18m	19325.66m	045.2588 (d)	192.38m
71	Line	193.64m		N28.628856W (d)	19325.66m	19519.30m		
72	Curve	221.64m	500.00m		19519.30m	19740.94m	025.3979 (d)	219.83m
73	Line	356.61m		N03.230954W (d)	19740.94m	20097.55m		
74	Curve	265.19m	300.00m		20097.55m	20362.74m	050.6476 (d)	256.64m
75	Line	135.87m		N47.416692E (d)	20362.74m	20498.61m		
76	Curve	212.34m	500.00m		20498.61m	20710.94m	024.3319 (d)	210.74m
77	Line	147.49m		N23.084807E (d)	20710.94m	20858.43m		
78	Curve	346.57m	400.00m		20858.43m	21205.00m	049.6418 (d)	335.83m
79	Line	506.95m		N72.726650E (d)	21205.00m	21711.95m		

No.	Chord Direction	Start Direction	End Direction	Mid-Ordinate	External Tangent	External Secant	PI Included Angle
1							
2	N65.533771W (d)	N62.938420W (d)	N68.129123W (d)	1.54	67.99m	1.54m	174.8093 (d)
3							
4	N63.590002W (d)	N68.129123W (d)	N59.050882W (d)	3.14	79.39m	3.15m	170.9218 (d)
5							
6	N52.517765W (d)	N59.050882W (d)	N45.984647W (d)	3.9	68.71m	3.92m	166.9338 (d)
7							
8	N18.362176E (d)	N45.984647W (d)	N82.708998E (d)	113.42	416.44m	261.98m	051.3064 (d)
9							
10	N05.212259W (d)	N82.708998E (d)	S86.866484W (d)	133.96	3829.53m	3693.06m	004.1575 (d)
11							
12	S75.283142W (d)	S86.866484W (d)	S63.699799W (d)	20.37	204.97m	20.79m	156.8333 (d)
13							
14	N81.925622W (d)	S63.699799W (d)	N47.551042W (d)	38.42	150.49m	46.55m	111.2508 (d)
15							
16	N26.654822W (d)	N47.551042W (d)	N05.758602W (d)	36.83	213.80m	39.43m	138.2076 (d)
17							
18	N15.302285W (d)	N05.758602W (d)	N24.845967W (d)	11.07	134.50m	11.23m	160.9126 (d)
19							
20	N18.178581W (d)	N24.845967W (d)	N11.511195W (d)	4.06	70.14m	4.09m	166.6652 (d)
21							
22	N36.497578W (d)	N11.511195W (d)	N61.483961W (d)	35.56	177.09m	39.24m	130.0272 (d)
23							
24	N51.484069W (d)	N61.483961W (d)	N41.484176W (d)	5.62	65.24m	5.71m	160.0002 (d)
25							
26	N46.705763W (d)	N41.484176W (d)	N51.927349W (d)	2.07	45.69m	2.08m	169.5568 (d)
27							
28	N29.462010W (d)	N51.927349W (d)	N06.996671W (d)	37.94	206.75m	41.06m	135.0693 (d)
29							
30	N82.838052W (d)	N06.996671W (d)	S21.320567W (d)	45.32	237.84m	185.29m	028.3172 (d)

No.	Chord Direction	Start Direction	End Direction	Mid-Ordinate	External Tangent	External Secant	PI Included Angle
31							
32	S71.274706W (d)	S21.320567W (d)	N58.771155W (d)	98.06	327.20m	152.42m	080.0917 (d)
33							
34	N74.385578W (d)	N58.771155W (d)	N90.000000W (d)	14.76	111.79m	15.33m	148.7712 (d)
35							
36	N69.554224W (d)	N90.000000W (d)	N49.108448W (d)	25.2	149.12m	26.89m	139.1084 (d)
37							
38	N14.603277W (d)	N49.108448W (d)	N19.901894E (d)	43.98	171.85m	53.37m	110.9897 (d)
39							
40	N09.950947E (d)	N19.901894E (d)	N00.000000E (d)	7.52	87.72m	7.64m	160.0981 (d)
41							
42	N31.822204E (d)	N00.000000E (d)	N63.644408E (d)	49.6	204.79m	58.38m	116.3556 (d)
43							
44	N31.822204E (d)	N63.644408E (d)	N00.000000E (d)	28.56	117.91m	33.61m	116.3556 (d)
45							
46	N03.531279E (d)	N00.000000E (d)	N07.062559E (d)	0.95	30.86m	0.95m	172.9374 (d)
47							
48	N43.649628E (d)	N07.062559E (d)	N80.236698E (d)	41.38	155.89m	51.53m	106.8259 (d)
49							
50	N51.579223E (d)	N80.236698E (d)	N22.921748E (d)	23.27	103.84m	26.52m	122.6851 (d)
51							
52	N46.050513E (d)	N22.921748E (d)	N69.179277E (d)	15.27	81.15m	16.61m	133.7425 (d)
53							
54	N37.835818E (d)	N69.179277E (d)	N06.492360E (d)	27.73	115.72m	32.47m	117.3131 (d)
55							
56	N58.136249E (d)	N06.492360E (d)	S70.219861E (d)	79.69	265.37m	128.41m	076.7122 (d)
57							
58	N84.276334E (d)	S70.219861E (d)	N58.772529E (d)	41.9	205.13m	46.42m	128.9924 (d)
59							
60	N81.932024E (d)	N58.772529E (d)	S74.908480E (d)	19.34	102.66m	21.04m	133.6810 (d)

No.	Chord Direction	Start Direction	End Direction	Mid-Ordinate	External Tangent	External Secant	PI Included Angle
61							
62	N79.175915E (d)	S74.908480E (d)	N53.260311E (d)	53.3	257.53m	59.26m	128.1688 (d)
63							
64	N09.717307E (d)	N53.260311E (d)	N33.825697W (d)	52.28	180.57m	72.12m	092.9140 (d)
65							
66	N09.712607E (d)	N33.825697W (d)	N53.250911E (d)	41.26	142.54m	56.92m	092.9234 (d)
67							
68	N34.940409E (d)	N53.250911E (d)	N16.629907E (d)	35.44	231.65m	37.33m	143.3790 (d)
69							
70	N05.999474W (d)	N16.629907E (d)	N28.628856W (d)	19.25	104.22m	20.85m	134.7412 (d)
71							
72	N15.929905W (d)	N28.628856W (d)	N03.230954W (d)	12.23	112.67m	12.54m	154.6021 (d)
73							
74	N22.092869E (d)	N03.230954W (d)	N47.416692E (d)	28.83	141.96m	31.89m	129.3524 (d)
75							
76	N35.250749E (d)	N47.416692E (d)	N23.084807E (d)	11.23	107.79m	11.49m	155.6681 (d)
77							
78	N47.905728E (d)	N23.084807E (d)	N72.726650E (d)	36.95	185.00m	40.71m	130.3582 (d)
79							

APPENDIX C – BRIEF INDICATIVE BUDGET

BUDGET

Construction: Train-tram network

Object: Train-tram network

SCCO:

ENO:

Customer:

Created by: Petr Vnenk

Date: 13th January 2014

Contractor:

I.No.	Item code	Description	MU	Total quantity	Unit price (CZK)	Total price (CZK)	Total mass
1	2	3	4	5	6	7	8
	1	**Earthworks**				**19,150,569.77**	**0.000**
1	111201101	Disposal of bushes and trees of trunk diameter up to 100 mm including roots from total area up to 1000 m2	m2	9,612.000	32.30	310,467.60	0.000
2	111201401	Burning of bushes and trees of trunk diameter up to 100 mm	m2	9,612.000	23.60	226,843.20	0.000
3	119001421	Temporary fixing of cables and cable lines from 3 loose cables	m	300.000	170.00	51,000.00	0.000
4	121101103	Topsoil removal with transport up to distance of 250 m	m3	1,854.000	48.90	90,660.60	0.000
5	162701105	Horizontal transport of excavated soil from rock cl. 1 to 4 up to 10000 m	m3	52,800.000	265.00	13,992,000.00	0.000
6	171101104	Placement of loose material from cohesive rocks into embankments compacted to 102 % PCT	m3	52,800.000	69.50	3,669,600.00	0.000
7	171151101	Compaction of embankment sides at every inclination and compaction of slope	m2	10,734.000	30.90	331,680.60	0.000
8	180401212	Meadow lawn founding by sowing in slope up to 1:2	m2	10,734.000	9.01	96,713.34	0.000
9	*005724740*	*seed stock grassy regional blend - slopes*	*kg*	*161.010*	*83.40*	*13,428.23*	*0.000*
10	182301133	Spread of topsoil area over 500 m2 in slope steeper than 1:5 layer thickness up to 200 mm	m2	10,734.000	34.30	368,176.20	0.000
	5	**Ways**				**173,311,946.00**	**94,987.670**
11	511532111	Ballast bed from coarse crushed aggregate	m3	26,658.000	933.00	24,871,914.00	47,984.400

I.No.	Item code	Description	MU	Total quantity	Unit price	Total price	Total mass
1	2	3	4	5	6	7	8
12	521454221	Installation of track fields UIC60 basement concrete sleepers without baseplates tension clamp fastening u distribution	m	19,847.000	833.00	16,532,551.00	0.000
13	*134911000*	*Rail UIC60 quality group I*	*t*	*1,215.840*	*25,900.00*	*31,490,256.00*	*1,215.840*
14	*592118970*	*sleeper equipped B - 91 S/1 - PA flexible without baseplates, clamp Skl.14*	*pcs.*	*16,887.000*	*2,120.00*	*35,800,440.00*	*5,133.648*
15	*134930010*	*Grooved tram rail NT 1 for city public transport*	*t*	*953.000*	*28,700.00*	*27,351,100.00*	*953.000*
16	*592118820*	*prestressed concrete sleeper TB - 93 APP 20-19 242 x 22 x 18,4 cm*	*pcs.*	*16,191.000*	*1,480.00*	*23,962,680.00*	*3,270.582*
17	543141111	Horizontal and vertical track leveling on concrete sleepers	m	19,847.000	88.00	1,746,536.00	0.000
18	564202221	Gravel sand base course under new track	m3	20,239.000	571.00	11,556,469.00	36,430.200
	9	**Other structures and works-demolition**				**1,141,439,304.49**	**26,250.998**
19	916991121	Concrete bed under curbs	m3	140.000	2,450.00	343,000.00	315.888
20	929595211	Cess adjustment into depth up to 100 mm	m2	3,886.000	40.90	158,937.40	0.000
	99	**Mass transport and others**				**1,141,940,825.75**	**25,935.111**
21	998242011	Mass transport of railway superstructure of inclination 0,8 %	t	121,238.668	149.00	18,064,561.58	0.000
22	935111211	Ditch gutter fitting into base concrete thk. 100 mm from concrete channel blocks w 800 mm	m	1,854.000	86.90	161,112.60	0.000
23	*592274970*	*channel block TBM 20-80 33x80x20 cm*	*pcs.*	*5,562.000*	*162.00*	*901,044.00*	*0.000*
24	9399001	Other objects on track - bridges, crossings	cpl	2.000	0.00	1,100,000,000.00	0.000
25	*404143100*	*turnout*	*pcs.*	*7.000*	*500,000.00*	*3,500,000.00*	*0.686*
26	*583336880*	*aggregate 32-63*	*m3*	*5,397.222*	*651.00*	*3,513,591.52*	*9,715.000*
27	*583439300*	*crushed aggregate 16-32*	*m3*	*6,746.528*	*831.00*	*5,606,364.77*	*12,143.750*
28	*583313450*	*aggregate 0-4*	*m3*	*115.047*	*772.00*	*88,816.28*	*218.590*
29	212752213	Drainage piping from plastic flexible tubes D up to 160 mm including bed open excavation	m	9,715.000	229.00	2,224,735.00	2,240.085

I.No.	Item code	Description	MU	Total quantity	Unit price	Total price	Total mass
1	2	3	4	5	6	7	8
30	*592123330*	*platform block 130/114 AZZ 107-19 199x100x130 cm*	*pcs.*	*700.000*	*5,790.00*	*4,053,000.00*	*903.000*
31	511316013	Filling between sleepers and thresholds from concrete C 16/20	m3	112.000	2,550.00	285,600.00	0.000
32	*592123140*	*cantilever slab KD-230Z AZZ 257-19 230x99,5x9,5 cm*	*pcs.*	*1,400.000*	*2,530.00*	*3,542,000.00*	*714.000*
		In total				**1,334,905,278.92**	**121,238.668**

APPENDIX D – PHOTOS OF THE CURRENT STATE

Figure 21 - A view of Dlouhá třída street in Havířov

Figure 22 - A view of Životice village from the very end of Dlouhá třída street in Havířov

Figure 23 - A view of Hlavní třída in Havířov

Figure 24 - Tram track section Černá louka - Hranečník in Ostrava

Figure 25 - Tram stop "Důl Zárubek" with an area of former railway yard

Figure 26 - Railway yard at Důl Zárubek coal mine

Figure 27 - A general view of Ostrava střed station

Figure 28 - Railway track Ostrava - Bohumín with Hrušov junction on the right side

Figure 29 - Rychvald junction

Figure 30 - Track near the city of Petřvald

Figure 31 - Railway station Orlová

Figure 32 - The old railway station of the city of Karviná

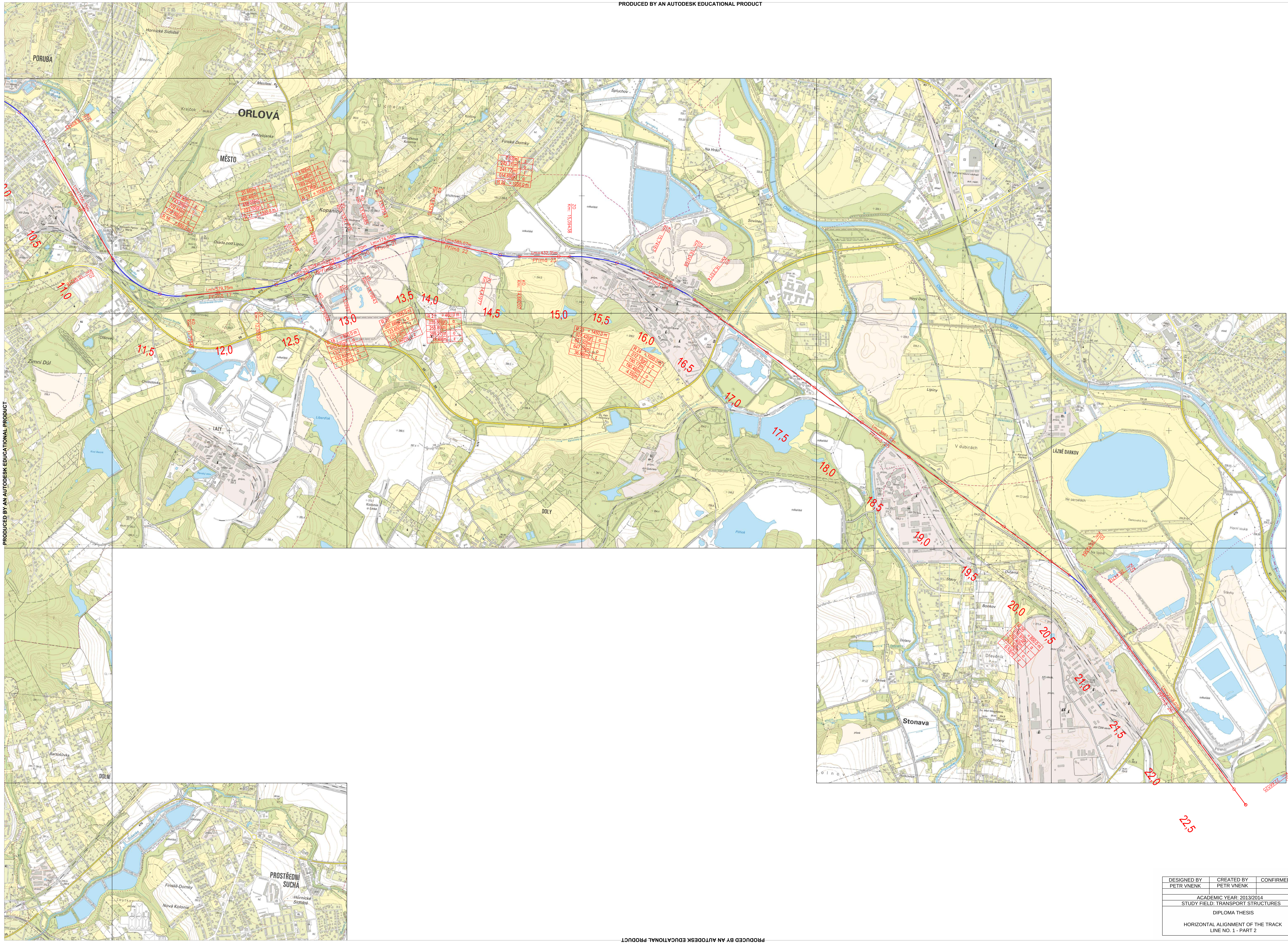
Figure 33 - Karviná-Darkov station

Figure 34 - A view over an area of proposed loop in Orlová

APPENDIX E – SET OF DRAWINGS

An essential part of this thesis is a set of drawings containing following items:

1. Horizontal alignment of the track; line No. 1 – part 1
2. Horizontal alignment of the track; line No. 1 – part 2
3. Horizontal alignment of the track; line No. 2 – part 1
4. Horizontal alignment of the track; line No. 2 – part 2
5. Horizontal alignment of the track; line No. 2 – part 3
6. Horizontal alignment of the track; line No. 3 – part 1
7. Horizontal alignment of the track; line No. 3 – part 2
8. Isochrone map (10 minutes/1000 m); part 1
9. Isochrone map (10 minutes/1000 m); part 2
10. Isochrone map (10 minutes/1000 m); part 3
11. Horizontal alignment of the track; Hranečník junction
12. Transport scheme of Ostrava střed station
13. Model cross-section of the track; rural area
14. Model cross-section of the track; urban area
15. Model cross-section of a platform; platform edge 550 mm above rail top
16. Model cross-section of a platform; platform edge 200 mm above rail top
17. Model profile of a platform; platform edge 200 and 550 mm above rail top



N
W E
S

LEGEND:

- CURVE
- LINE

Přímá = LINE

ZÚ = START OF A SECTION
KÚ = END OF A SECTION
ZO = START OF A CURVE
KO = END OF A CURVE
DECIMAL SEPARATOR = "COMMA" EXCEPT FOR RADII

DESIGNED BY	CREATED BY	CONFIRMED BY	JAN PERNER TRANSPORT FACULTY	
PETR VNENK	PETR VNENK			
ACADEMIC YEAR: 2013/2014			DATE	1 DEC 2013
STUDY FIELD: TRANSPORT STRUCTURES			FORMAT	16 x A4
DIPLOMA THESIS			NO. OF DRAWING	2
HORIZONTAL ALIGNMENT OF THE TRACK LINE NO. 1 - PART 2			MEASURING SCALE 1:10000	

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ACADEMIC YEAR: 2013/2014			DATE	1 DEC 2013
STUDY FIELD: TRANSPORT STRUCTURES			FORMAT	16 x A4
DIPLOMA THESIS			NO. OF DRAWING	1
HORIZONTAL ALIGNMENT OF THE TRACK LINE NO. 1 - PART 1			MEASURING SCALE 1:10000	

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ACADEMIC YEAR: 2013/2014			DATE	1 DEC 2013
STUDY FIELD: TRANSPORT STRUCTURES			FORMAT	8 x A4
DIPLOMA THESIS			NO. OF DRAWING	4
HORIZONTAL ALIGNMENT OF THE TRACK LINE NO. 2 - PART 2			MEASURING SCALE 1:10000	

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ACADEMIC YEAR: 2013/2014			DATE	1 DEC 2013
STUDY FIELD: TRANSPORT STRUCTURES			FORMAT	8 x A4
DIPLOMA THESIS			NO. OF DRAWING	5
HORIZONTAL ALIGNMENT OF THE TRACK LINE NO. 2 - PART 3			MEASURING SCALE 1:10000	

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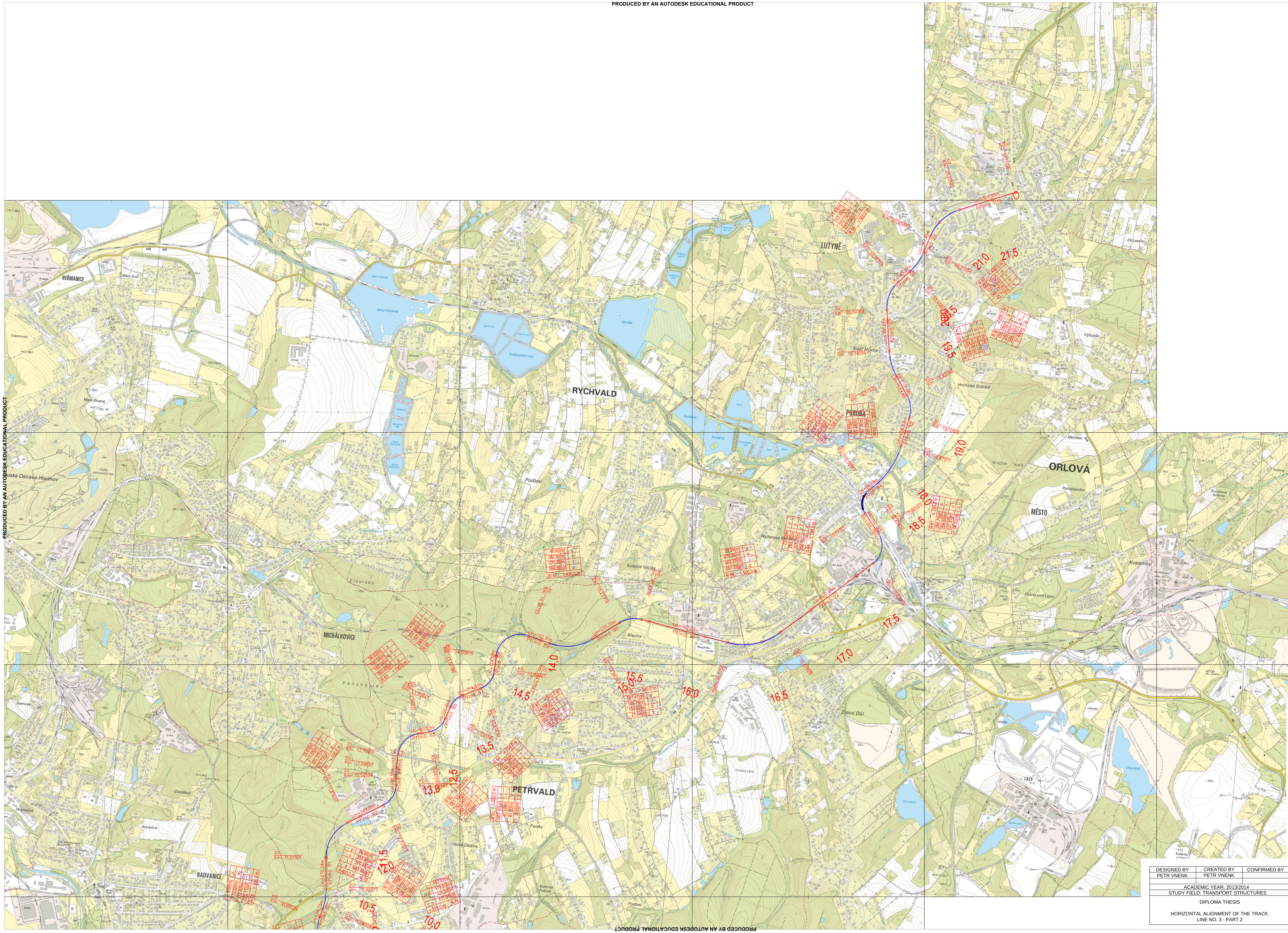
ACADEMIC YEAR: 2013/2014	DATE	1 DEC 2013
STUDY FIELD: TRANSPORT STRUCTURES	FORMAT	8 x A4
DIPLOMA THESIS	NO. OF DRAWING	3
HORIZONTAL ALIGNMENT OF THE TRACK LINE NO. 2 - PART 1	MEASURING SCALE	1:10000



N
W E
S

LEGEND:

CURVE

LINE

Přímá = LINE

ZÚ = START OF A SECTION

KÚ = END OF A SECTION

ZO = START OF A CURVE

KO = END OF A CURVE

DECIMAL SEPARATOR = "COMMA" EXCEPT FOR RADII

DESIGNED BY	CREATED BY	CONFIRMED BY	JAN PERNER TRANSPORT FACULTY	
PETR VNENK	PETR VNENK			
ACADEMIC YEAR: 2013/2014			DATE	1 DEC 2013
STUDY FIELD: TRANSPORT STRUCTURES			FORMAT	16 x A4
DIPLOMA THESIS			NO. OF DRAWING	7
HORIZONTAL ALIGNMENT OF THE TRACK LINE NO. 3 - PART 2			MEASURING SCALE 1:10000	

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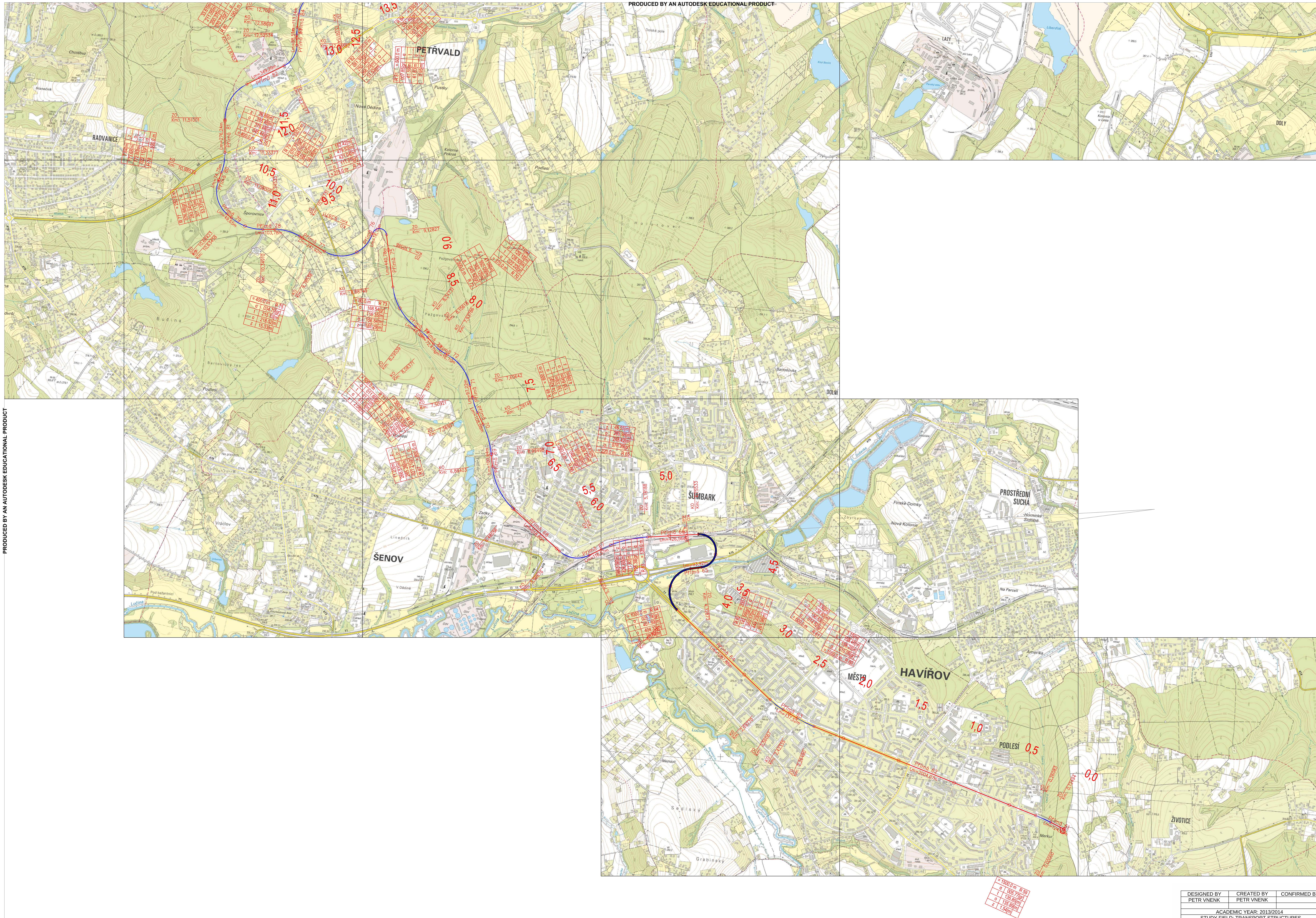
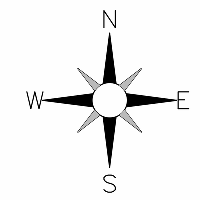
PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT
PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT





LEGEND:

(blue line)	CURVE
(red line)	LINE

Přímá = LINE

ZÚ = START OF A SECTION
KÚ = END OF A SECTION
ZO = START OF A CURVE
KO = END OF A CURVE
DECIMAL SEPARATOR = "COMMA" EXCEPT FOR RADII

DESIGNED BY	CREATED BY	CONFIRMED BY	JAN PERNER TRANSPORT FACULTY	
PETR VNENK	PETR VNENK			
ACADEMIC YEAR: 2013/2014			DATE	1 DEC 2013
STUDY FIELD: TRANSPORT STRUCTURES			FORMAT	16 x A4
DIPLOMA THESIS			NO. OF DRAWING	6
HORIZONTAL ALIGNMENT OF THE TRACK LINE NO. 3 - PART 1			MEASURING SCALE 1:10000	

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PETR VNENK	PETR VNENK			
ACADEMIC YEAR: 2013/2014			DATE	23 DEC 2013
STUDY FIELD: TRANSPORT STRUCTURES			FORMAT	16 x A4
DIPLOMA THESIS			NO. OF DRAWING	9
ISOCHRONE MAP (10 MINUTES/1000 m) PART 2			MEASURING SCALE 1:10000	

DESIGNED BY	CREATED BY	CONFIRMED BY	JAN PERNER TRANSPORT FACULTY	
PETR VNENK	PETR VNENK			
ACADEMIC YEAR: 2013/2014			DATE	23 DEC 2013
STUDY FIELD: TRANSPORT STRUCTURES			FORMAT	16 x A4
DIPLOMA THESIS			NO. OF DRAWING	10
ISOCHRONE MAP (10 MINUTES/1000 m) PART 3			MEASURING SCALE 1:10000	

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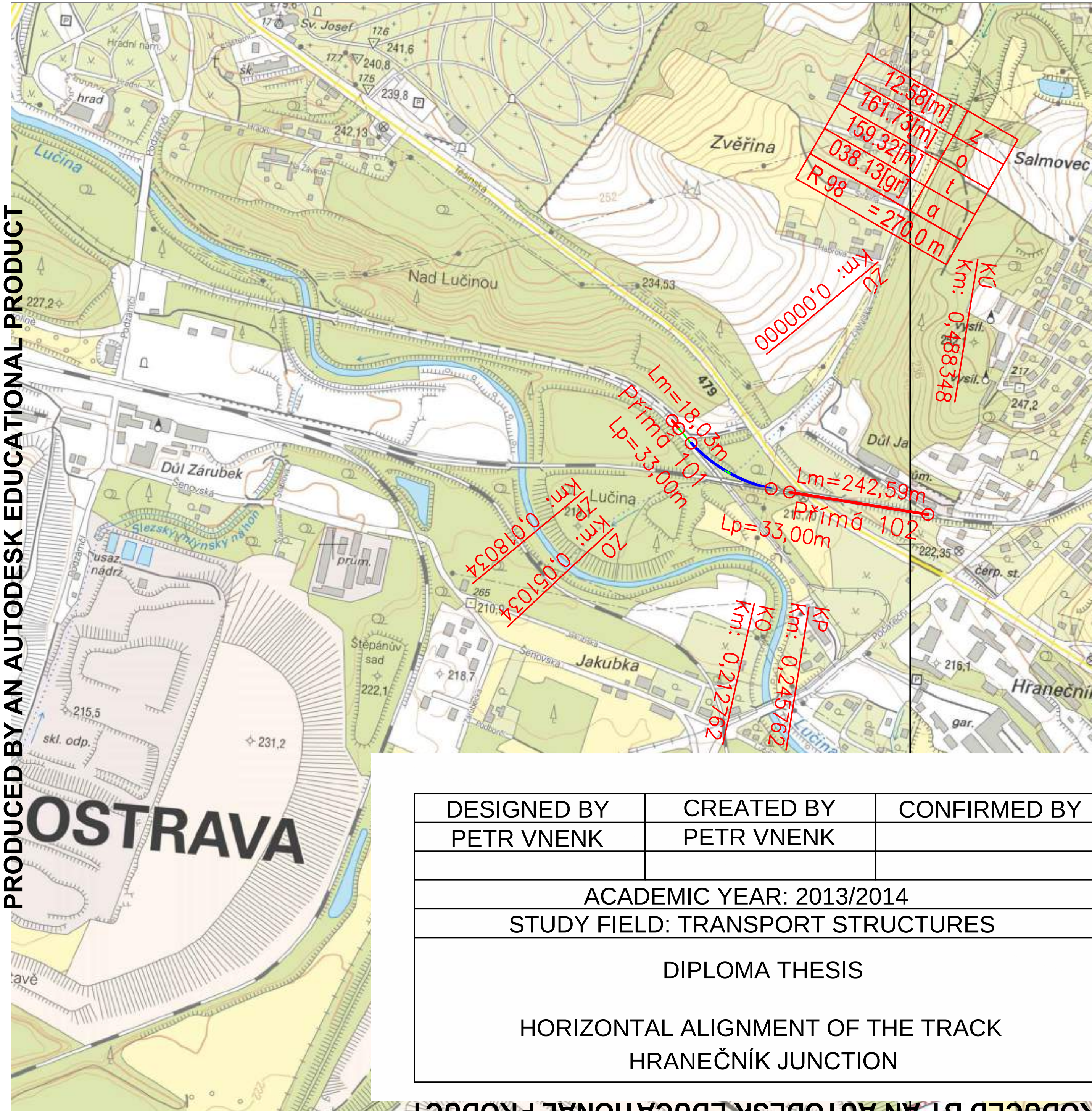
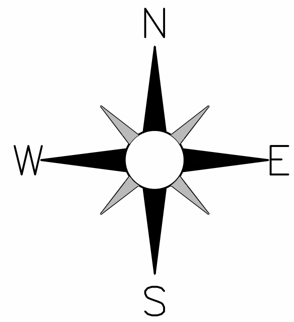
PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT

DESIGNED BY	CREATED BY	CONFIRMED BY	JAN PERNER TRANSPORT FACULTY	
PETR VNENK	PETR VNENK			
ACADEMIC YEAR: 2013/2014			DATE	23 DEC 2013
STUDY FIELD: TRANSPORT STRUCTURES			FORMAT	16 x A4
DIPLOMA THESIS			NO. OF DRAWING	8
ISOCHRONE MAP (10 MINUTES/1000 m) PART 1			MEASURING SCALE 1:10000	





LEGEND:
- SPIRAL
- CURVE
- LINE

Přímá = LINE
ZÚ = START OF A SECTION
KÚ = END OF A SECTION
ZO = START OF A CURVE
KO = END OF A CURVE
ZP = START OF A SPIRAL
KP = END OF A SPIRAL
DECIMAL SEPARATOR = "COMMA" EXCEPT FOR RADII

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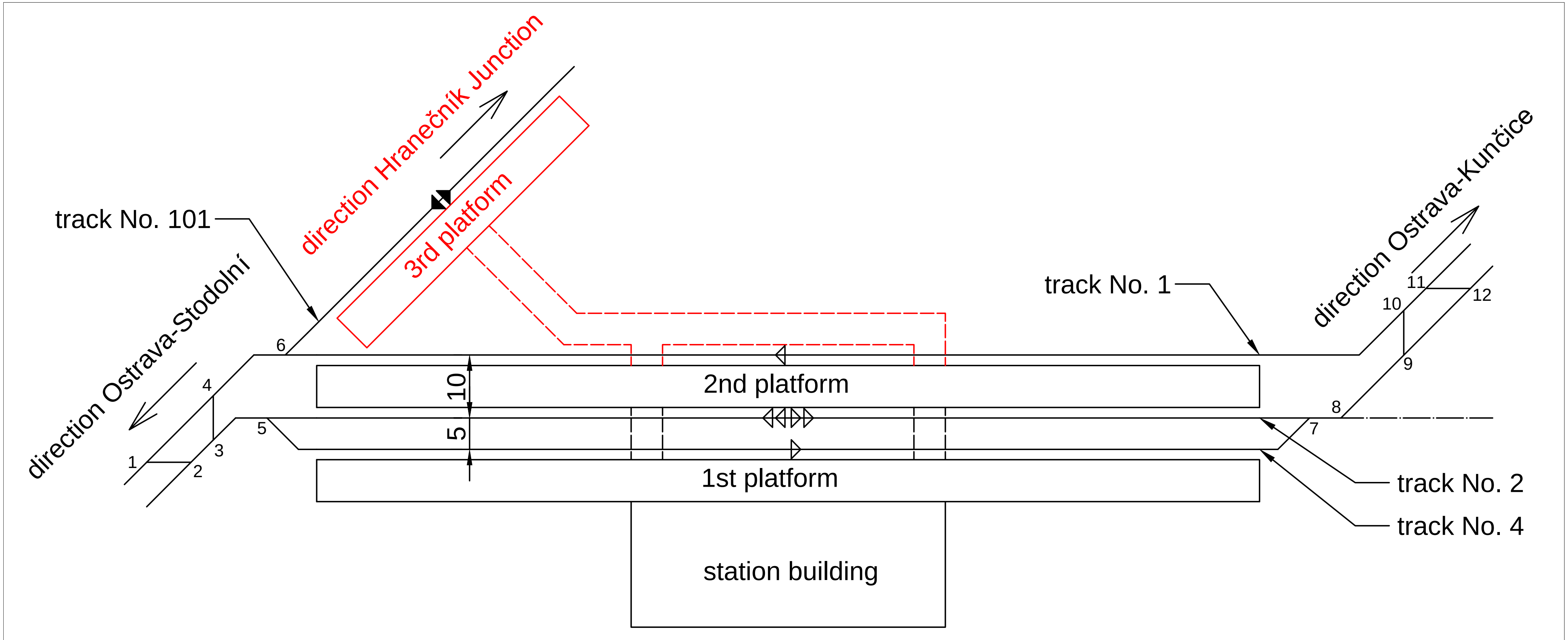
PETR VNENK	PETR VNENK			
ACADEMIC YEAR: 2013/2014			DATE	29 DEC 2012
STUDY FIELD: TRANSPORT STRUCTURES			FORMAT	1 x A4
DIPLOMA THESIS			NO. OF DRAWING	11
HORIZONTAL ALIGNMENT OF THE TRACK HRANEČNÍK JUNCTION			MEASURING SCALE 1:10000	



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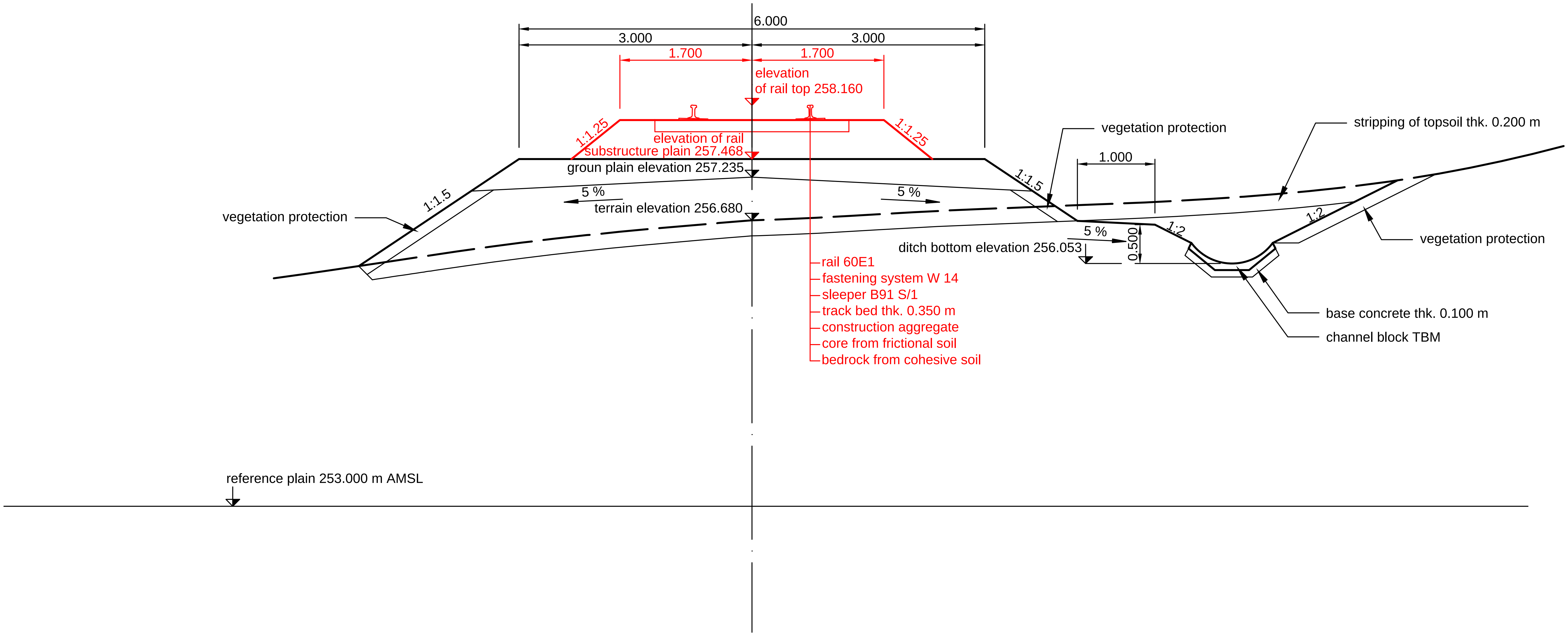
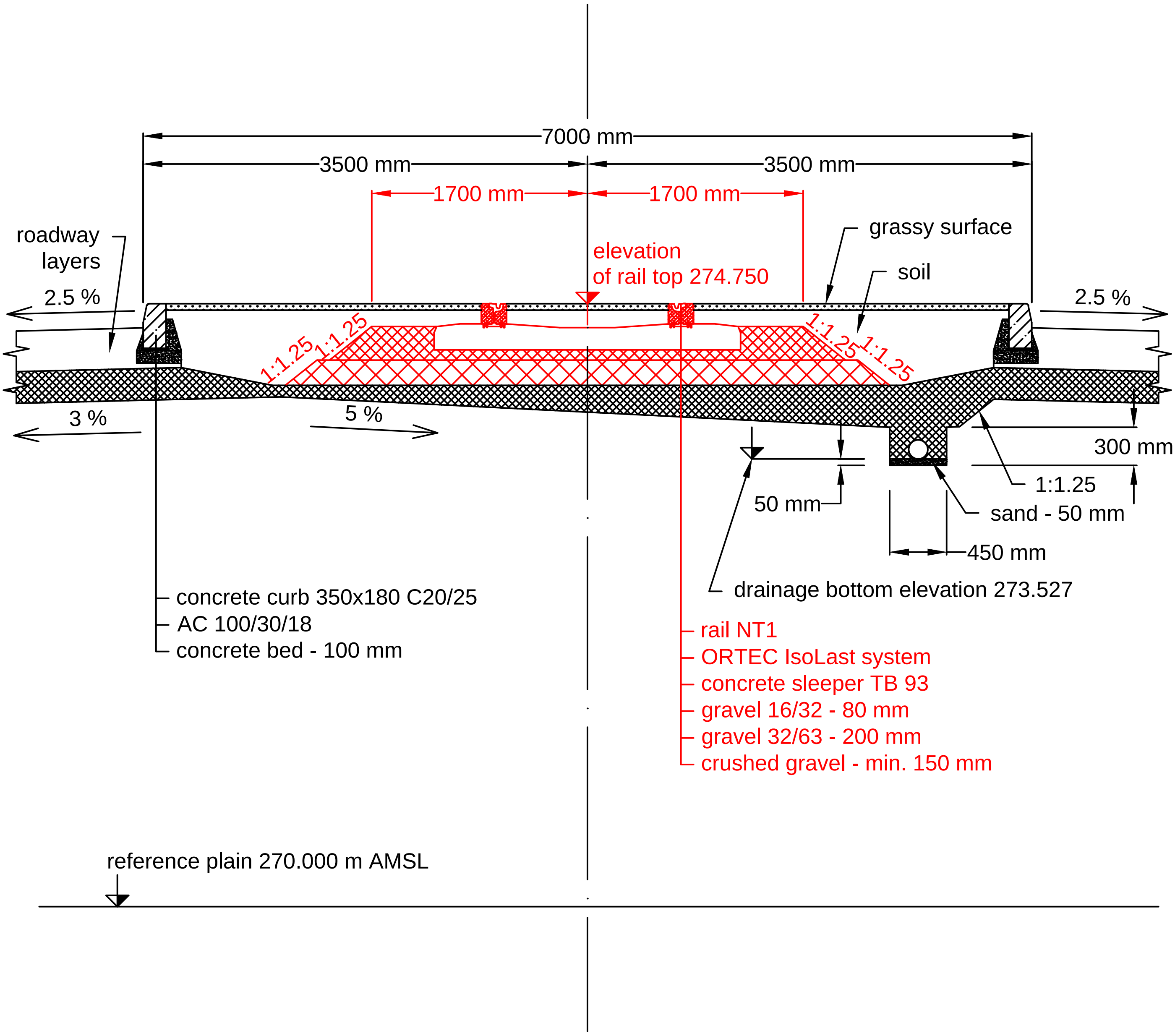
PETR VNENK	PETR VNENK			
ACADEMIC YEAR: 2013/2014			DATE	30 DEC 2013
STUDY FIELD: TRANSPORT STRUCTURES			FORMAT	A4
DIPLOMA THESIS TRANSPORT SCHEME OF OSTRAVA STŘED STATION			NO. OF DRAWING	12

Model cross-section
Line No. 3
Km 13.950000

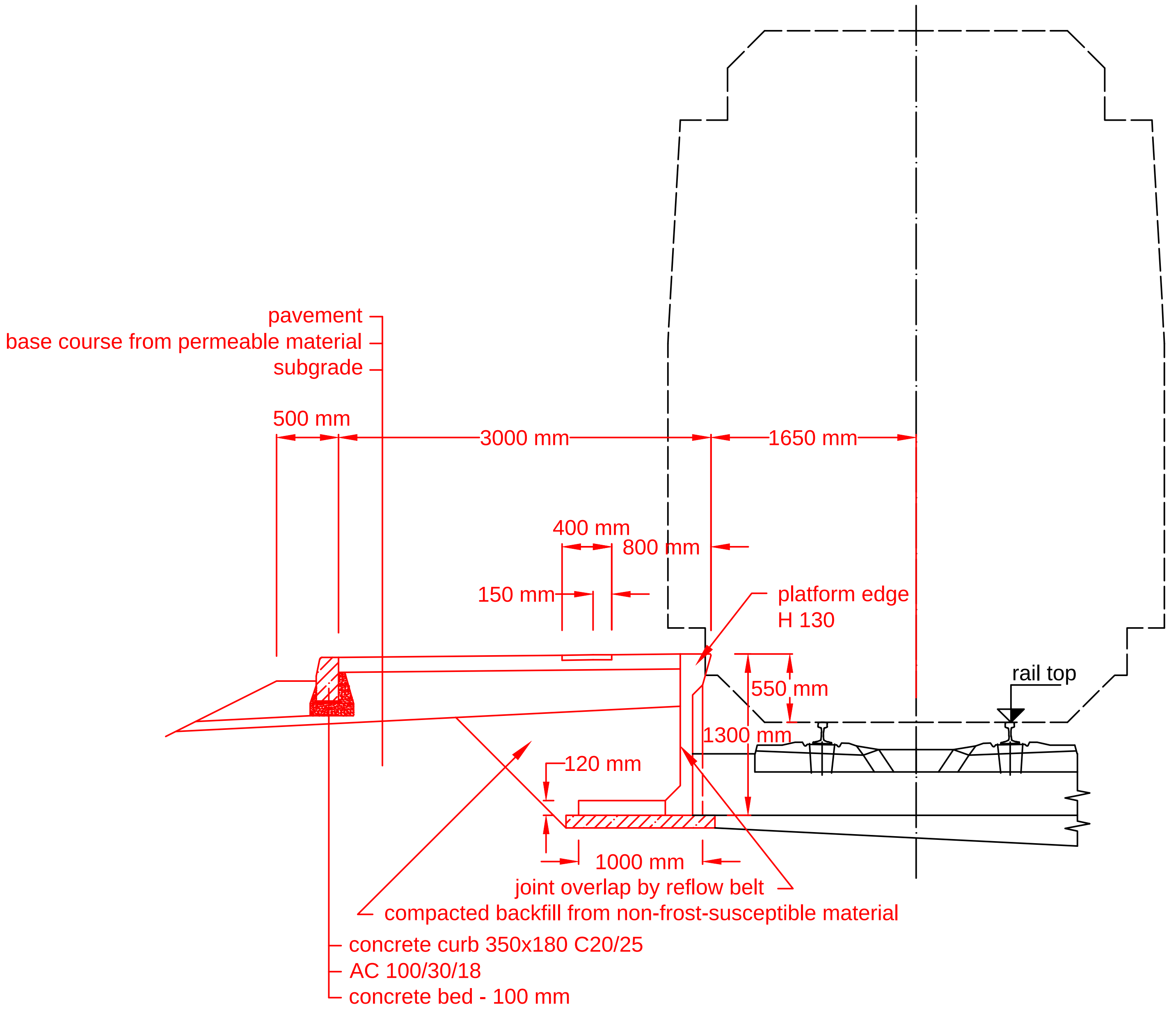


DESIGNED BY	CREATED BY	CONFIRMED BY	JAN PERNER TRANSPORT FACULTY	
PETR VNENK	PETR VNENK			
ACADEMIC YEAR: 2013/2014			DATE	30 DEC 2013
STUDY FIELD: TRANSPORT STRUCTURES			FORMAT	2 x A4
DIPLOMA THESIS			NO. OF DRAWING	13
MODEL CROSS-SECTION OF THE TRACK RURAL AREA			MEASURING SCALE 1:50	

Model cross-section
Line No. 3
Km 3.000000



DESIGNED BY	CREATED BY	CONFIRMED BY	JAN PERNER TRANSPORT FACULTY	
PETR VNENK	PETR VNENK			
ACADEMIC YEAR: 2013/2014			DATE	30 DEC 2013
STUDY FIELD: TRANSPORT STRUCTURES			FORMAT	A4
DIPLOMA THESIS MODEL CROSS-SECTION OF THE TRACK URBAN AREA			NO. OF DRAWING	14
			MEASURING SCALE 1:50	



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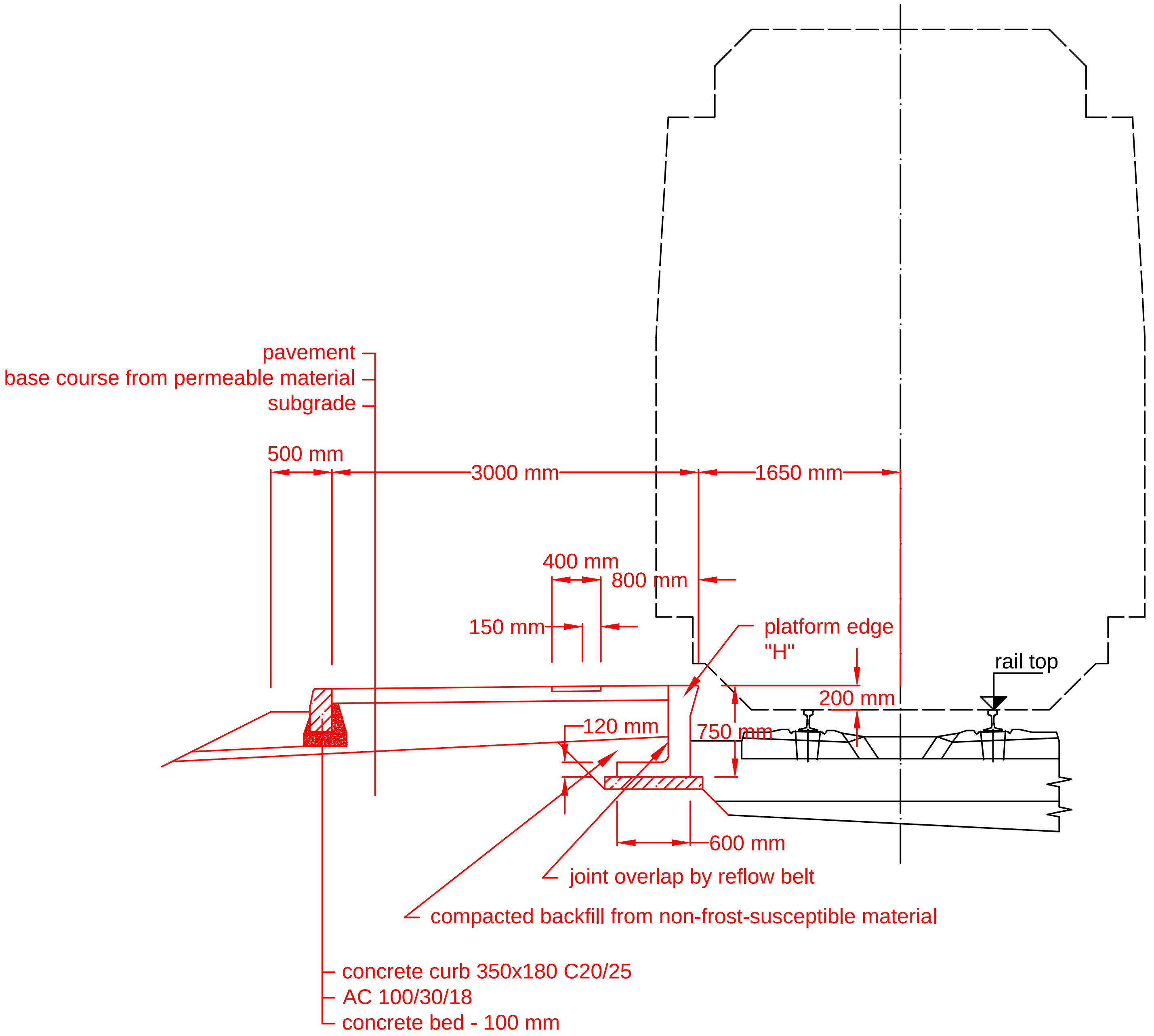
PETR VNENK	PETR VNENK			
ACADEMIC YEAR: 2013/2014			DATE	31 DEC 2013
STUDY FIELD: TRANSPORT STRUCTURES			FORMAT	A4
DIPLOMA THESIS MODEL CROSS-SECTION OF A PLATFORM PLATFORM EDGE 550 mm ABOVE RAIL TOP			NO. OF DRAWING	15
			MEASURING SCALE 1:50	



DESIGNED BY	CREATED BY	CONFIRMED BY	JAN PERNER TRANSPORT FACULTY	
PETR VNENK	PETR VNENK			
ACADEMIC YEAR: 2013/2014			DATE	31 DEC 2013
STUDY FIELD: TRANSPORT STRUCTURES			FORMAT	A4
DIPLOMA THESIS MODEL CROSS-SECTION OF A PLATFORM PLATFORM EDGE 200 mm ABOVE RAIL TOP			NO. OF DRAWING	16
			MEASURING SCALE 1:50	

DESIGNED BY	CREATED BY	CONFIRMED BY	JAN PERNER TRANSPORT FACULTY	
PETR VNENK	PETR VNENK			
ACADEMIC YEAR: 2013/2014			DATE	31 DEC 2013
STUDY FIELD: TRANSPORT STRUCTURES			FORMAT	11 x A4
DIPLOMA THESIS			NO. OF DRAWING	17
MODEL PROFILE OF A PLATFORM PLATFORM EDGE 200 AND 550 mm ABOVE RAIL TOP			MEASURING SCALE 1:50	